Post Nuclear Attack Temporary Housing

Literature Review and Preliminary Recommendations

For Canada Mortgage and Housing Corporation
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SYNOPSIS

Within the overall scope of a nuclear attack there will be a need to provide adequate housing for thousands of displaced individuals and families. This study was undertaken to review existing literature and other information sources dealing with the provision of temporary housing for a one to three year period following a nuclear attack. The study records existing guidelines that may be applicable, and suggests areas for future investigation.

The review was limited by time to the following sources:

a) existing CMHC documentation

b) a computer literature search by the Canadian Housing Information Centre

c) discussions with agencies and housing manufacturers in the Ottawa area.

Information was organized within two major "frameworks".

Planning - dealing with issues and data concerning site selection and site development

Building - dealing with various types of housing units and their appropriateness for post nuclear attack situations.

These frameworks contain general guidelines, for both site development and unit design, obtained from existing literature sources.

After an initial review, adaption of existing facilities and the provision of temporary modified barracks type accommodation appears to be the most likely choice for post nuclear attack temporary housing. Existing stock of pre-manufactured unit types, eg. mobile homes, could also be utilized, but it appears that this stock is not very large and that a number of manufacturing plants are located in target areas.

The above recommendations are however, very preliminary as a great many of the parameters for decisions concerning the development of a post nuclear attack housing plan are unknown. The recommendations for future study listed below have been developed so that these parameters can be established and a viable post nuclear housing plan developed.

Recommendations for future study:

1. All future study done after development of detailed civil defence plan attack scenario based on imperical studies not assumptions.

2. Review of U.S. and European (particularly Swiss and Swedish) civil defence approaches to post attack housing.

3. Inventory of resources that would be available for provision of housing after an attack.

4. Research effects of nuclear fallout on buildings and building design.

5. Social research on effects of greatly increasing housing densities.

6. Develop overall nuclear attack housing plan, including guidelines and documentation for local implementation.

In a recent study of the effects of a nuclear attack on the state of Ohio it was estimated that with a co-ordinated civil defence plan 82% of the population would survive a large scale nuclear attack; without one, 83% of the population would die, 8,820,000 individuals out of a total population of 10,700,000.[1]

The figures speak for themselves we must have a post nuclear attack housing plan as part of an overall civil defence plan; however this plan must be based on a thorough understanding of all parameters of a nuclear attack before it is developed. If a plan is developed with only partial understanding some vital factor may be overlooked and the plan may contribute to the overall disaster rather than reducing its impact.

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1. Sullivan, R., Guthe, K., Thoms, W., Adelman, F., Survival During the First Year After a Nuclear Attack, Arlington VA, System Planning Corp., 1979.

PART I - APPROACH

1.0 Introduction

In an era of growing international tension, it is unrealistic to ignore the possibilities of Canada's involvement in a nuclear war. Although all peoples of the world abhor the thought of such a war, it is necessary to understand its ramifications on our society and to formulate a civil defense strategy to deal with it.

Within the overall scope of civil defence there will be a need to provide adequate housing for thousands of deplaced individuals and families.

As a start to understanding the problem of providing this housing it would appear that one of the first steps would be a review of existing data bases and the identification of areas requiring further research.

The purpose of this study is to review existing data and suggest areas of future study concerning the provision of post nuclear attack temporary housing.

1.2 Terms of Reference

The terms of reference for this study were outlined in Appendix "A" of the contract executed 10 December 1981. They are as follows:

Title

Review and report on existing information concerning emergency housing and site planning.

Issue

The Canada Mortgage and Housing Corporation promotes all forms of housing design and planning solutions. In recent years, natural and man-made catastrophies, have received increased attention as they related to the relocation and housing for large numbers of people. Taking into consideration the worst possible man-made catastrophe, such as nuclear war, planning and designing of the worst conditions becomes the relevant issue as it relates to the availability of sites, construction materials, energy, transportation, existing prefab accommodation, mobile units such as trailers, campers or any kind of structure or vehicles that could be utilized for accommodation under an emergency situation.

Objective

To provide Canada Mortgage and Housing Corporation with an information report based on existing sources. To assist in the design and site planning considerations for accommodation under emergency or extreme emergency conditions.

The content of this report will:

1) Identify the housing and site problems under emergency conditions.

2) Based on existing information, define the principles which should guide decisions about site selection and site layout design, grading, orientation and utilization of design features to minimize the use of energy.

3) Relate decisions regarding the selection of construction materials, methods of construction in relation to the different climatic regions of Canada.

4) Highlight the principles to establish priorities in the selection of housing accommodation in remote areas for construction and mining camps, which could be applied for emergency situations, e.g., selection of prefab units or construction of new units, depending on the circumstances or availability of any of the above.

5) Based on previous experiences for construction or mining camps in remote areas, describe site layout solutions considering the availability or lack of energy, services, water, and number of units or population.

1.3 Methodology

The first stage of the study was the review of existing data. This review took the following form:

1. review existing data in possession of client.

2. computer search of existing computer data banks under a number of key headings:

   - Emergency Housing, Nuclear
   - Emergency, Planning, Nuclear Fallout
   - Civil Defence
   - Emergency Housing

   Databases contacted:

   - NTIS Database
   - Safety Science Database
   - Smithsonian Science Database
   - Management Contents Database
   - Cold Regions Database

   Computer search was carried out by Canadian Housing Information Centre.

   Canadian Institute for Scientific and Technical Information was also contacted re computer search and could suggest no further action than had already been taken.

3. review of pertinent documents identified in the search.

4. establish contact with agencies in the Ottawa area that might deal with emergency housing.

   - Energy Mines and Resources - suggested contacting manufacturers re standards for mining and remote resource camps.

   - National Defense - data concerning typical barracks type accommodation.

   - ATCO Eastern - data concerning standards for mining and remote resource camps.

The material reviewed has been organized within two major frameworks:

Planning - dealing with issues and data concerning site selection and site development.

Building - dealing with various types of housing units and their appropriateness for application to post nuclear situations.

The final section of the study deals with the identification of areas requiring further research.

1.4 Assumptions

1. That Canada have in effect a fully operational Civil Defence Plan - i.e., evacuation plans, stock piling of food, identification of shelter spaces, annual public education programs, etc.

2. Nuclear attack scenario (developed and agreed to by consultant and CMHC to establish parameters for this study).

   Phase 1

   - general population in attack areas given 72 hrs. warning of potential attack. Population evacuated to non target areas e.g., surrounding small communities.

   - emergency housing plus fallout shelter space will be provided for a duration of 1 - 2 weeks. This may have to be extended up to 1½ months while temporary housing is being constructed. This type of space will be minimal in nature and will probably be provided in existing structures or very temporary ad hoc type structures that would not be acceptable for long term habitation.

   Phase 2

   - provision of temporary housing for evacuees while damaged areas are being repaired and rebuilt. Duration of habitation 1 - 3 years.

   Phase 3

   - construction of permanent housing for relocated population i.e., those who will not be able to return to previous location.

   This study will deal exclusively with phase 2 of this scenario.

3. If the goal of society after a major nuclear attack is regeneration not just survival, major damaged areas will have to be rebuilt and society returned to its preattack status.

4. Because of the varied building and planning resources available in various locations across the country and the potentially different priorities after a nuclear attack, this study is not specifically directive in nature but will try to identify general guidelines, that can be used to develop a future manual to assist local authorities in specific decision making.

5. Limited but varied supplies of building materials will be available outside attack areas.

6. Emergency orders and regulations would provide for price controls and the rationing of supplies in the relocation areas.

7. That other emergency agencies would provide for the necessary health and food services for the surviving population.

8. That a system of justice and law enforcement would be restablished after an attack.

9. Contracting and financing of emergency housing are outside the terms of reference of this study.

10. After the attack, Canada could decide for itself how to proceed and would not be forced to follow the instructions of another country e.g., USSR (i.e., Canada did not "lose" the war.)

PART II - PLANNING FRAMEWORKS

2.1 General Notes

This section of the study contains a summary of recommendations for the selection and development of new sites for post nuclear attack temporary housing. They are general guidelines and can be used for sites developed with a variety of unit types. Section 2.8 illustrates some examples of siting recommendations and layouts for particular unit types.

The recommendations are organized by a series of planning subsystems.

1. Movement
2. Support Service/Health
3. Land Use
4. Social/Cultural Impact
5. Landscape/Natural Systems

Each section dealing with a subsystem will contain a series of criteria to assist in the evaluation and selection of building sites. It will also contain directives for the development of designated sites.

2.2 Movement Systems

2.2.1 Site Selection

1. for ease of access the site should be close to an existing paved road. Access should minimize disruption to existing communities. e.g., the main site access should not be off a small local residential street. [1]

2. should be gently sloping (less than 8%) and have no major physical features (e.g., large rock out croppings, ravines etc.) that would impede construction of internal roads. [1]

3. be close to public transit route if it exists. [1] (may not be important if major fuel sources are destroyed).

2.2.2 Development Directives

1. roads - gravel 150 mm base course, 50 mm surface course. [1]
   - 4572 mm - 6096 mm turning radius at all right angle turns.

2. intersections - wye intersections with angles less than 45° and cross intersections e.g., those having four or more legs should be avoided. [2]

   - 45m is a desireable minimum spacing between intersections. [2]

   -buildings, trees and hedges should be set back sufficiently at intersections to permit good visibility in all directions. [2]

3. snow removal - take into consideration snow plowing operations and provide snow dumping areas.

4. parking - 1 space/unit [1]
   - guest - 1 space/4 units [1]
   - locate guest parking at entry to site (beside managers unit or at major community/amenity area.

   * Note parking spaces will probably be used to store vehicle used in evacuation until fuel supplies for personal auto use are restored.

5. pedestrian cirulation - should be separated from vehicular circulation whenever possible.

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1. Abbles, Schwartz & Assoc./Beyer Blinder Belle PC; site Selection and Design for Disaster Housing Group Sites. Washington, 1976

2. Siting and Airfield Zoning C-98.001.003/MS.003, National Defence, 77.05.06

2.3 Support Services/Health Systems

2.3.1 Water

1. Site Selection

. Must have potable water in one of following conditions:

a) tap into existing system if adequate supply exists (125 - 140 gallons/unit/per day with water conservation devices) [1]

b) ground water - shallow well or drill deep well.

c) surface water. There are conflicting theories to the radiation hazard of surface water. Warren Shields, M.D. and Stanley Suberbach in Survival and the Bomb suggest Strontuim 90 and Cesium 137 can build up in the body to health destroying levels. They suggest its removal if surface water is to be used. (no method presently exists).[2] The Stanford Research institute feels no harmful effects will be felt by adults although children may suffer thyroid damage from Iodine 13.[3]

2. Development Directives

. Protection of Sources

In any program of water sanitation the first consideration is the protection from pollution of available sources of water supply. Second protect unsuitable sources from unauthorized use. [4]. Water quality should be checked on a regular basis by an officer of health or other qualified official.

. Distribution

Depending on unit type water can either be distributed to individual units by pipe or truckage (500 gal./unit storage tank suggested. [1]) or can be picked up at a central supply. (very inconvenient for a 1-3 year period).

- Treatment

  a) surface water can be treated for I.13 contamination with the use of SSKI (saturated solution of potassium iodide) [3]

  b) all natural water supplies should be chlorinated before distribution.

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1. Abbles, Schwartz and Assoc./Beyer Blinder Belle; Site Selection and Design for Disaster Housing Group Sites. Washington, 1976.

2. Wigner Eugene P., ed., Survival and the Bomb, Indiana University Press, 1969.

3. Sullivan, R., Guthe, K., Thoms, W., Adelman, F., Suivival During the First Year after a Nuclear Attack. Arlington VA, System Planning Corp., 1979.

4. National Defence, Canadian Forces Health Manual, CFB 213, 1975.

2.3.2 Sewage Disposal

1. Site Selection

- close to existing sanitary sewer with adequate capacity to service total no. of units to be developed. (125 gallons/day/unit). [1]

- if septic fields are used, soils must be of adequate type to accept septic fields and should not contaminate existing local water supplies.

- soils should allow for trenching of sewers, preferably gravity system.

- if external latrines are used soils must allow excavation and also prevent contamination of drinking water.

2. Site Development

- Minimize length of utility lines to individual units as this is the most expensive aspect of site development. [1]

- Sewage disposal systems.

a) Trucking of sewage would probably not be used, because of of storage of fuel supplies for trucks.

b) Septic fields

- shouldn't be used for sites larger than 100 units.
- place and number will depend on soil type.
- refer to provincial regulations for sizing and installation.
- should not be located closer than 15.24 m preferably 30.48 m to any actual or potential water supply. [2]

c) Gravity or pressure pipeline to activated sludge treatment plant

The use of these systems determined by slope of site and subsurface conditions. Pressure systems should be avoided if possible because of limited availability of pumps and energy to run pump and potential mechanical breakdown.

d) External latrines and grease pits. This is the most basic sewage disposal system. It can be used but has many potential health and pollution hazards if used over a long period of time and in high densities. For detailed explanation of construction methods refer to National Defence, - Canadian Forces Health Manual, CFP213.

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1. Abbles, Schwartz and Assoc./Beyer, Blinder and Belle, Site Selection and Design for Disaster Housing Group Sites, Supporting Technical Data, Washington, 1976.

2. National Defence, Canadian Forces Health Manual, CFP-213, 1975.

2.3.3 Electrical Power Supply

1. Site Selection

   . Should be close to existing main electrical lines (no figures could be found in existing literature re load requirements).

2. Development Directives

   . to reduce cost and provide ease of access for maintenance all supply lines should be pole mounted.

   . diesel generation may be used if no direct supply exists. This will depend on availability of fuel and equipment. It is suggested that the limited fuel supply could probably not be used for light generation but only for emergency electrical requirements-water pumps, hospitals, etc. [1]

   . if electricity is not immediately available planning and layout should not preclude its future provision.

   . if units are separate they should be individually metered to encourage conservation.

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1. Sullivan, R. et al, Survival During the First Year After a Nuclear Attack, Arlington VA, System Planning Corp., 1979.

2.3.4 Refuse Disposal

1. Site Selection

   No specific requirements

2. Development Directives

   - pick-up from individual units 1 - 2 times/week and take to existing landfill site.
   - if multiple units, refuse should be stored in central containers - fly proof, water tight, rodent proof, while awaiting pick-up.
   - see Canadian Force Health Manual CFP-213 for a more in depth discussion of sanitary refuse disposal including directives for establishing land fill sites.

2.3.5 Decontamination

1. Site Selection

- sites should be checked for fallout contamination.
- no directives were found for choosing sites that might have less likely amount of airborn contamination.

2. Development Directives

- sites should be decontaminated before construction starts. This may entail the washing down of large areas and the removal of soil and vegetation if high levels of contamination exist.
- levels of radiation humans can indure.

  200 rads - causes sickness
  300 rads - serious hemorrhagic manifestations
  450 rads - lethal dose for half the exposed population
  750 rads - no survival [1].

- levels of 1000 R/hr. will exist even after 1-2 weeks in many areas. The size and location of these areas can only be estimated from attack simulations. No data was found for Canada. ("Survival During the First Year After a Nuclear Attack" provides a detailed analysis of the affects on Ohio of a nuclear attack. This study could be used as a model for Canadian study).

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1. Wigner, Eugene P, ed., Survival and the Bomb, Indiana University Press, 1969.

2.4 Land Use

2.4.1 Site Selection

- slightly sloping land to allow natural drainage - 2% - 8% slope.
- no major natural features that would hinder construction.
- avoid flood plains, swampy land, avalanche areas.
- in areas of black fly and mosquito infestation, avoid cedar stands and low wet lands.
- soils - sandy soils preferable for drainage
  - clay type soils should be avoided if possible
  - bearing capacity should be confirmed for type of construction anticipated.
- adjacent land use should be compatible, avoid - industrial areas, refuse dumps, major transportation arteries, airports, polluted water sources.
- residential area and auxillary uses (waste disposal) should not adversly effect adjacent land uses.

2.4.2 Development Directives

- amenity areas - 8% of site area [1]
  (see 2.5 Social/Cultural Impact for more detailed directives)
- set backs - side and rear yards - 4.572 m
  - front yard - 4.572 - 9.144 m [1]
- fire separation of structures - row houses and apartments 10 m.
  - mobile homes 5 m. [2]

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1. Abbles Schwartz and Assoc./Beyer Blinder and Belle, Site Selection and Design for Disaster Housing Group Sites, Washington, 1976.
2. National Defence, Siting and Airfield Zoning, C-98.001.003/MSn 03, 1977.

2.5 Social/Cultural Impact

The overall condition of the population after an attack will be one of fear and disorientation. The provision of safe housing that simulates pre attack social conditions could help greatly in the restoration and reconstruction of society.

2.5.1 Site Selection

- before choosing any new group sites, all available existing structures and infill sites should be utilized to maximize integration into the existing host community. This integration will reduce feelings of alienation by the evacuees and anomosity toward the evacuees from the host community.

- new sites should be as close as possible to existing community facilities:

  recreational
  shopping
  cultural
  educational

  This will further integrate evacuees and it will reduce costs of providing temporary facilities for new sites.

- sites (mobile home) should not contain more than 125 units, above this number social unrest has been observed. [1]

2.5.2 Development Directives

- provide an area of 8% of site for amenity/recreation area, of which 9.29 m^2/unit should be play ground. Play ground should have visual access from majority of dwellings and be separated from major vehicular traffic. [2]

- provide central laundry facility. 1 washer/17 dwelling units, 1 dryer/4washers. [2]

- provide area for central mail pick or provide individual delivery.

- large sites 100-125 units, provide site management facility and area for community meetings if none is available.

- day care facilities will be required if all adult population is to participate in reconstruction.

- provide identification graphics, directory of occupants and unit numbering system.

2.5.3 Social Directives

- families and previous neighbourhood ties should be retained in relocation if possible to reduce social tension. [3]

- care should be taken not to make the new sites "new permanent communities" that have all the facilities of older communities. This may reduce or stop people's will to return and reconstruct their previous homes and communities. [4]

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1. Abbles, Schwartz and Assoc./Beyer Blinder and Belle. Site Selection and Design for Disaster Housing Group Sites, Supporting Technical Data, 1976, p.61.

2. Abbles, Schwartz and Assoc.,/Beyer Blinder and Belle, P.C., Site Selection and Design for Disaster Housing Group Sites, Washington 1976.

3. Abbles, Schwartz and Assoc.,/Beyer Blinder Belle, Cost Effective Housing Systems for Disaster Relief Vol, 4., p. 153.

4. Abbles, Schwartz and Assoc./Beyer Blinder and Belle, Site Selection and Design for Disaster Housing Group Sites, Supporting Technical Data, 1976, pp. 121-122.

2.6 Landscape/Natural Systems

2.6.1 Site Selection

- avoid sites with major natural features, e.g., heavily treed, large rock outcrops, large ravines and creek beds, major sloped areas.

- sites should have some natural vegetation (shrubs, mature trees etc.) that can be incorporated into a landscape plan. This will reduce erosion and help to give the site a finished appearance from the beginning of development.

- ascertain soil bearing capacity to confirm that selected unit types can be constructed on site.

2.6.2 Development Directives

- disturb as little of existing vegetation and grading to help reduce problems of erosion and water drainage (this may not be possible in heavily contaminated areas).

- use indigenous and fast growing species.

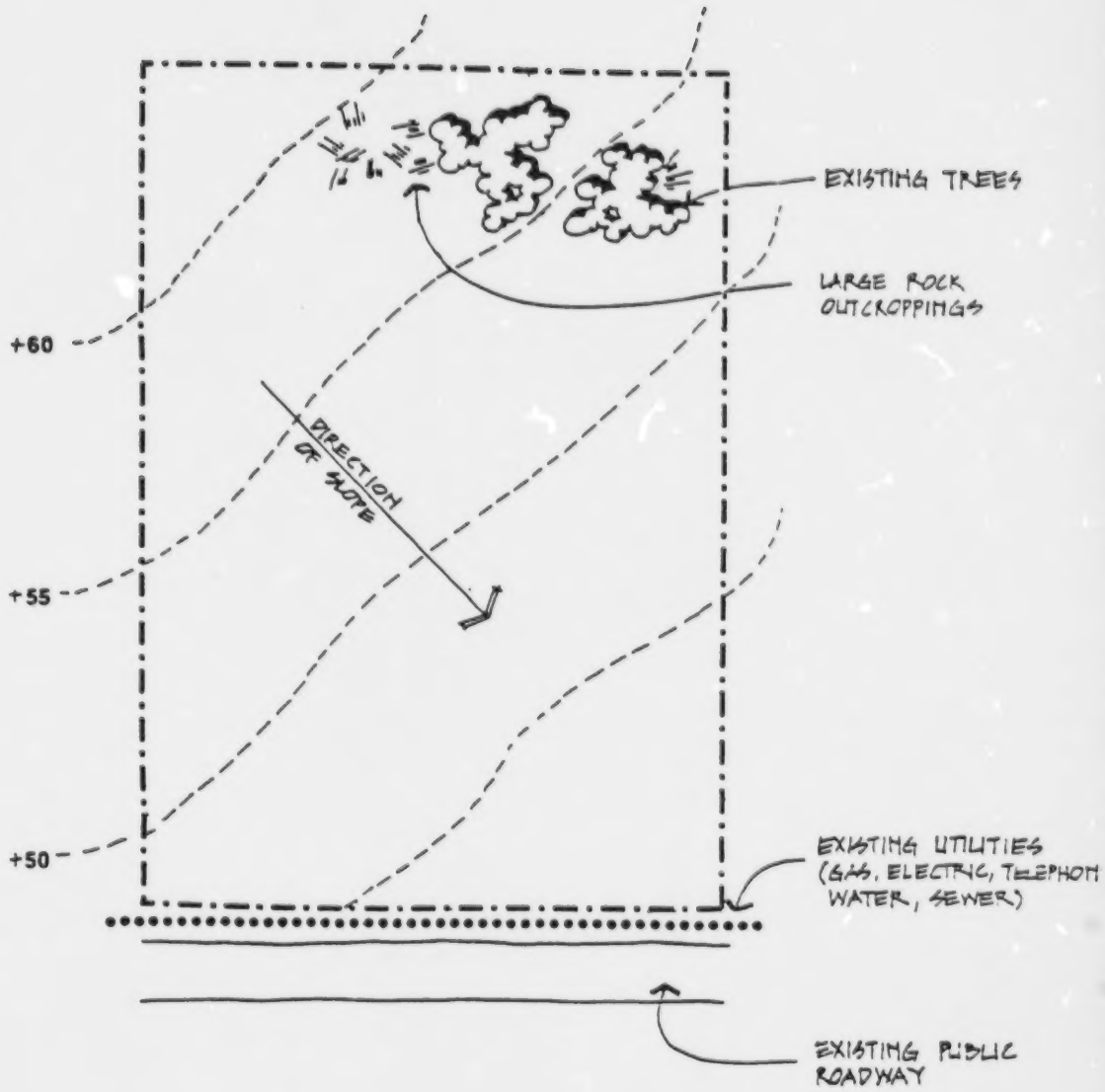
- be aware that sites may only be used for 1-3 years, choose materials accordingly.

2.7 Typical Site Development Guidelines

This section of the study contains some standards and site planning guidelines that have been developed by various agencies for temporary or emergency housing situations.

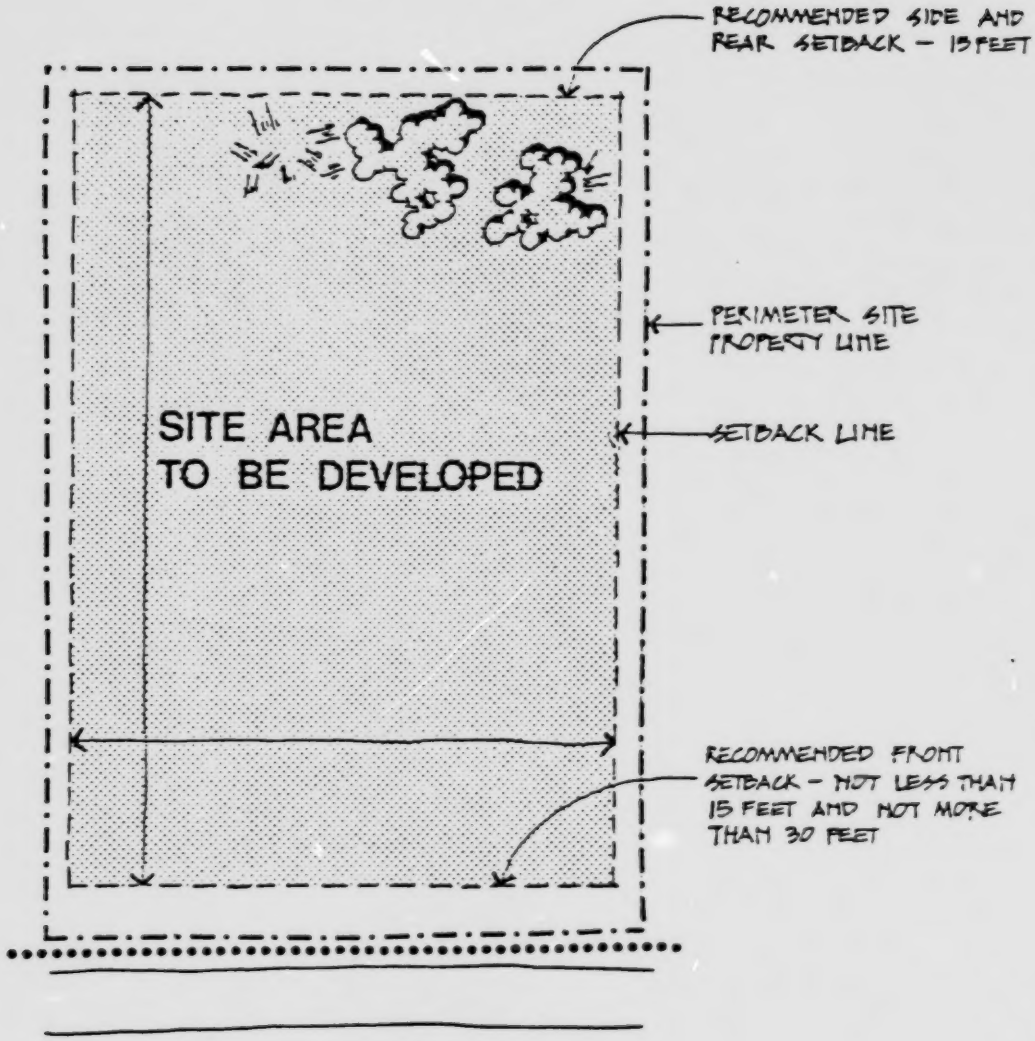
2.7.1 Disaster Housing

Guidelines prepared for United States Department of Housing and Urban Development to deal with the deployment of emergency housing for natural disaster victims. These guidelines were developed in the aftermath of hurricane Agnes that devistated parts of New York and Pennsylvania in 1972. Although the type of units concerned are modified mobile homes, a number of the guidelines could be applied to other unit types. The book these guidelines are contained in, Site Selection and Design for Disaster Housing Group Sites Guidebook, Abbles, Schwartz and Assoc.,/Beyer Blinder, Belle, is the only literature specifically oriented to planning for the emergency housing requirement that the consultant found during the literature search.



2 Identify site features.

Identify all existing structures, large rock outcroppings, wooded areas, lakes, ponds and streams which may either be an asset to the total site design or interfere with the maneuvering and positioning of mobile home units on the site. Direction of sunlight, slope, prevailing breeze and desirable view should also be noted so that appropriate unit orientations can be determined.

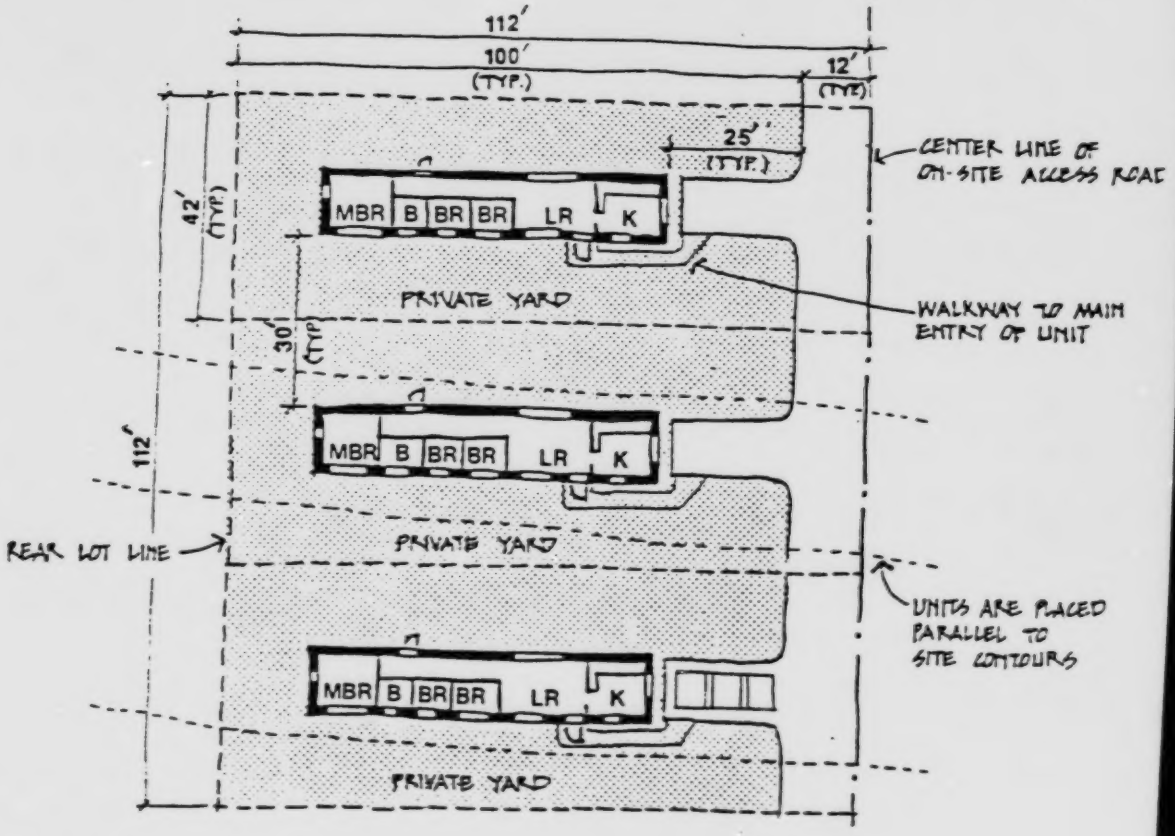

RECOMMENDED SIDE AND REAR SETBACK – 15 FEET
PERIMETER SITE PROPERTY LINE
SETBACK LINE
SITE AREA TO BE DEVELOPED
RECOMMENDED FRONT SETBACK – NOT LESS THAN 15 FEET AND NOT MORE THAN 30 FEET

3 Establish site and setback dimensions.

Determine the net area of the site after subtracting 15 ft. setbacks which must be provided at the perimeter property line of the site (allow a 30 ft. setback at the "front" of the site where possible).

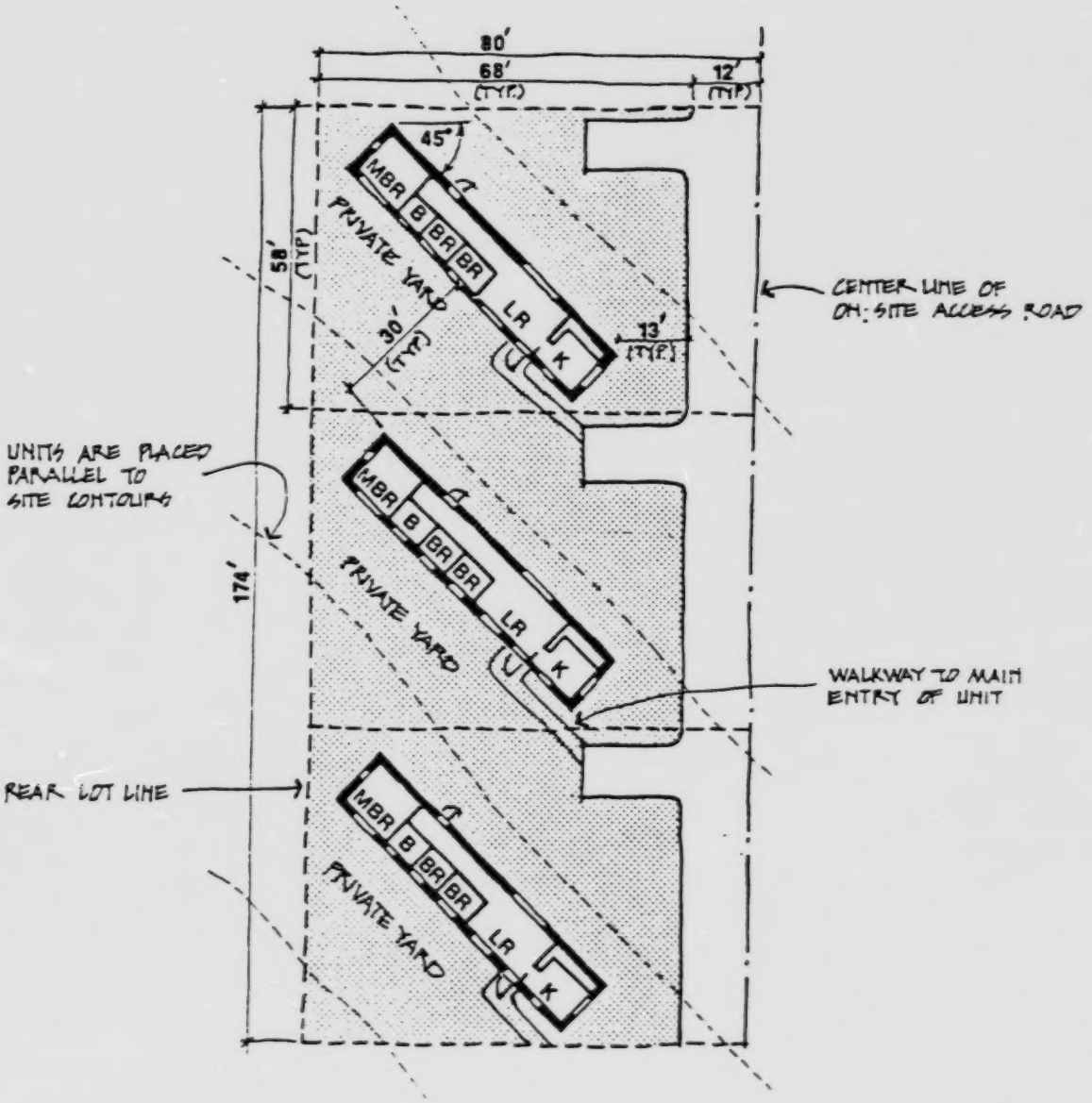
4 Lay out lots.

Two prototypical lot sizes, lot prototype "A" and lot prototype "B", are recommended for the development of temporary mobile home group sites.



PROTOTYPE 'A' (42 FEET x 112 FEET)

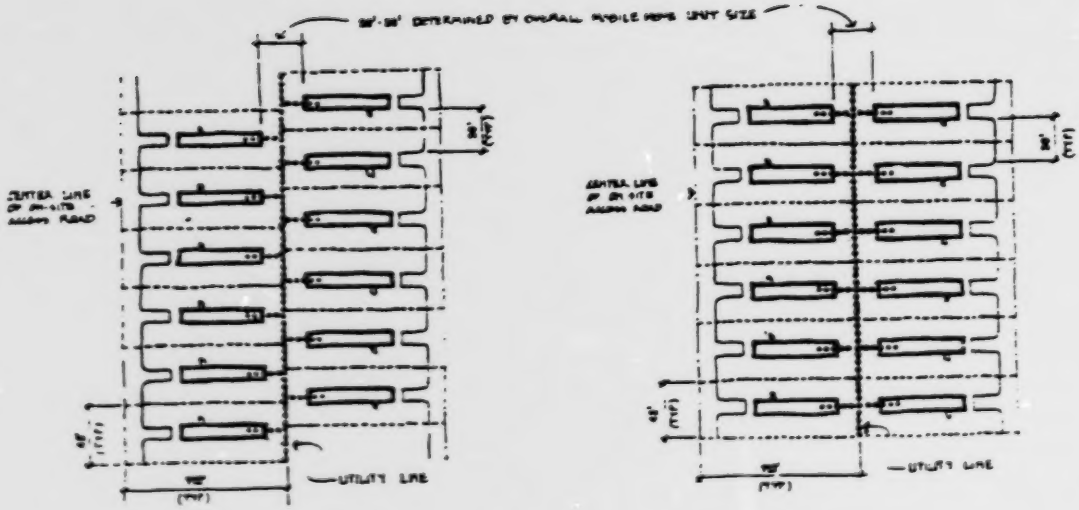
NOTE: THE 12 FOOT x 65 FOOT MOBILE HOME SHOWN ABOVE IS ONE TYPE OF UNIT WHICH MAY BE USED AT TEMPORARY DISASTER GROUP SITES. INTERIOR LAYOUTS AND OVERALL UNIT DIMENSIONS MAY VARY.

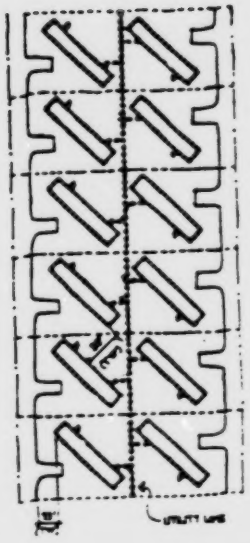


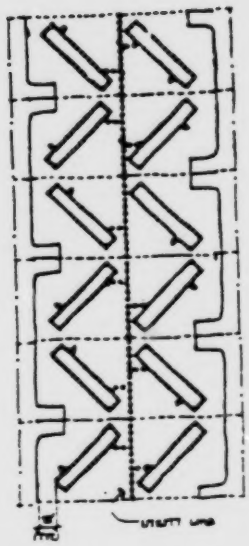
PROTOTYPE 'E' (58 FEET x 80 FEET)

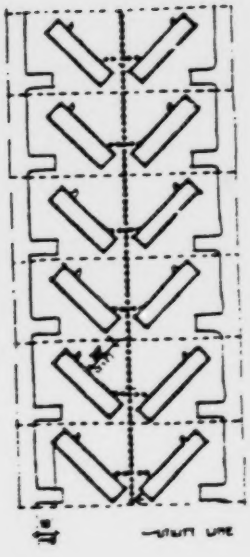
NOTE: THE 12 FOOT x 65 FOOT MOBILE HOME SHOWN ABOVE IS ONE TYPE OF UNIT WHICH MAY BE USED AT TEMPORARY DISASTER GROUP SITES. INTERIOR LAYOUTS AND OVERALL UNIT DIMENSIONS MAY VARY.

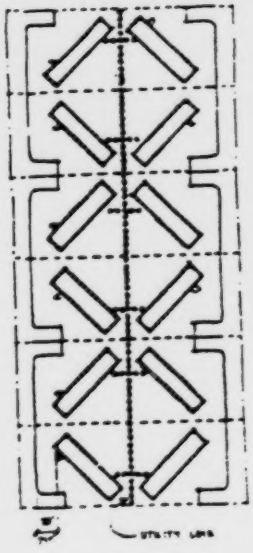
Each lot prototype, when placed two abreast or back-to-back, as shown in the unit layout variations, provides the most efficient arrangement of mobile home, utility connection and on-site roadway. Unit layout variations for lot prototype "A" are indicated below. Layout variations for lot prototype "B" are shown opposite.



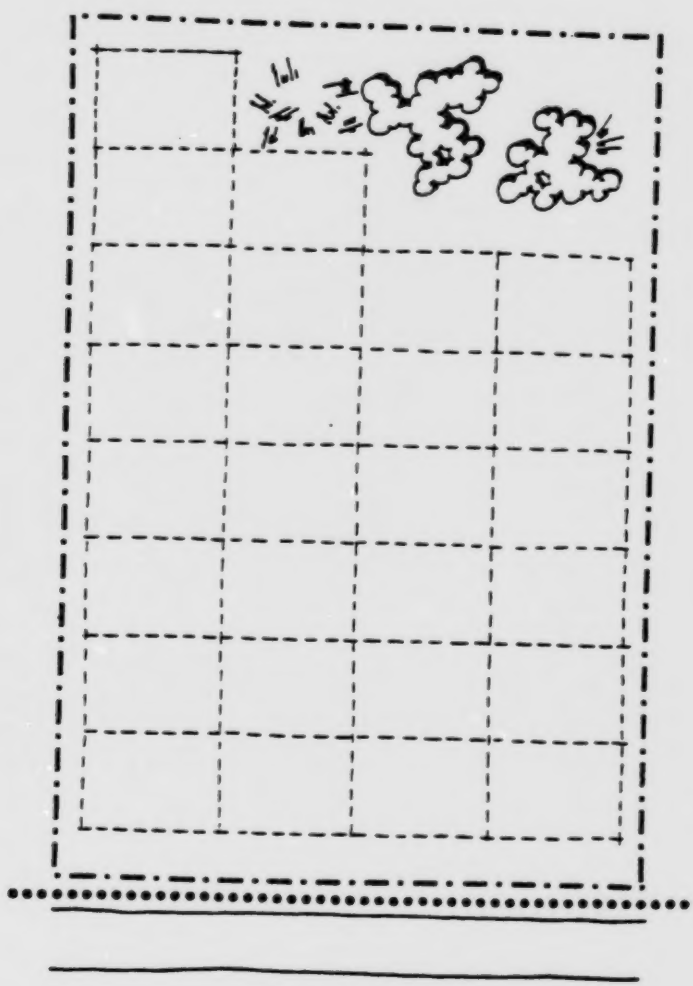








Arrange the required number of lots within the net site area in an even and simple order. Consideration should be given to the physical and natural site features identified in Step 2 so as to achieve a site plan which will maximize the use of such features while providing an efficient and simple lot layout.



LOT PROTOTYPE 'B' IS MORE APPROPIATE FOR THIS SITE THAN LOT PROTOTYPE 'A' DUE TO THE 320 FOOT SITE WIDTH.

The planner should note that it is not necessary to provide additional space between lots for on-site access roadways. The required roadway width has been provided for within the lot prototype size, as discussed in Step 6.

The two given lot prototypes ('A' and 'B') may be used in combination or one lot prototype may be used exclusively throughout the site plan. The planner may find that only one of the lot prototypes is appropriate for a particular site or that one is more appropriate than the other due to either site donditions or dimensions. This is the case in the site example shown opposite. Lot prototype 'B' can more efficiently utilize the site.

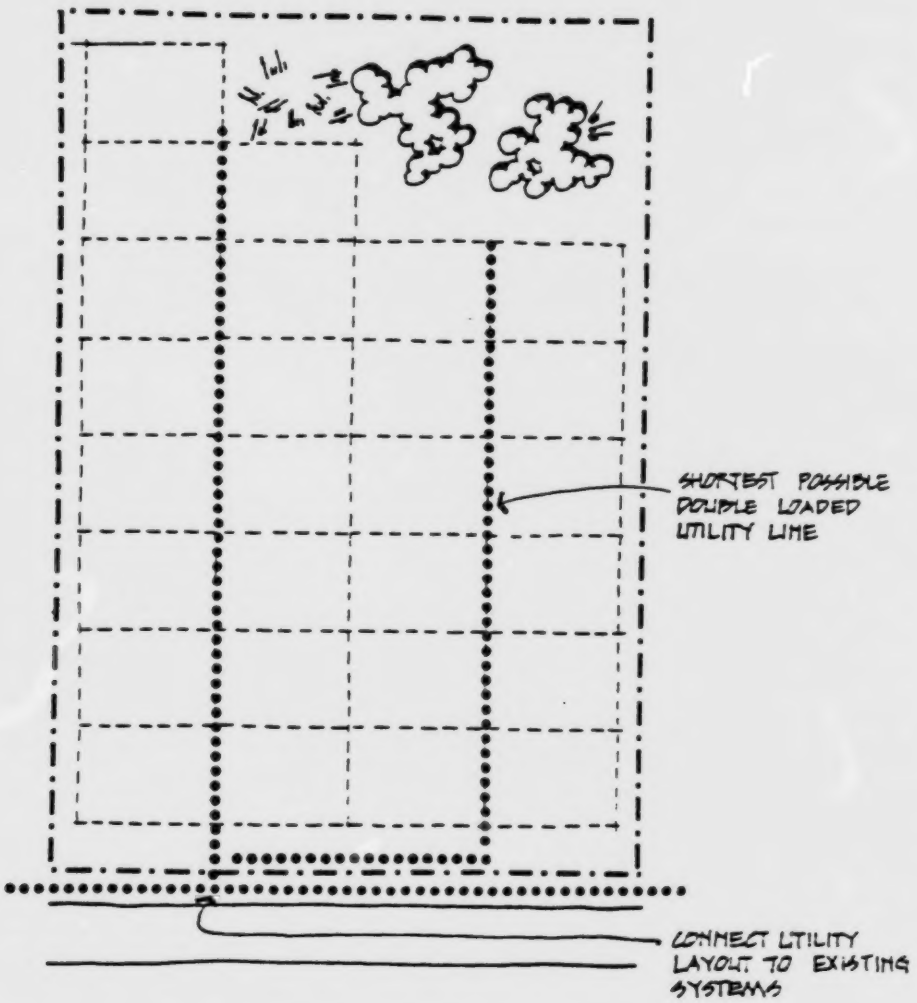
5 Lay out on-site utilities.

Plot an on-site utility line of the shortest distance necessary to service all units.

Since installation costs of new on-site utilities are greater than any other site development factor, the planner should always minimize the total linear footage of utility line required by aligning all utilities at the rear lot line between lots placed two abreast, as shown.

This alignment, or the "double loading" of utilities (servicing of units on both sides of the utility line), will result in the most efficient and least costly utility layout.

"Single loading" or the alignment of utilities at the perimeter of the site (servicing only one side of the utility line), will result in the increase of total linear footage of utility and, in effect, increase its total cost. The single loading of utilities should, therefore, be avoided.


SHORTEST POSSIBLE
DOUBLE LOADED
UTILITY LINE
CONNECT UTILITY
LAYOUT TO EXISTING
SYSTEMS

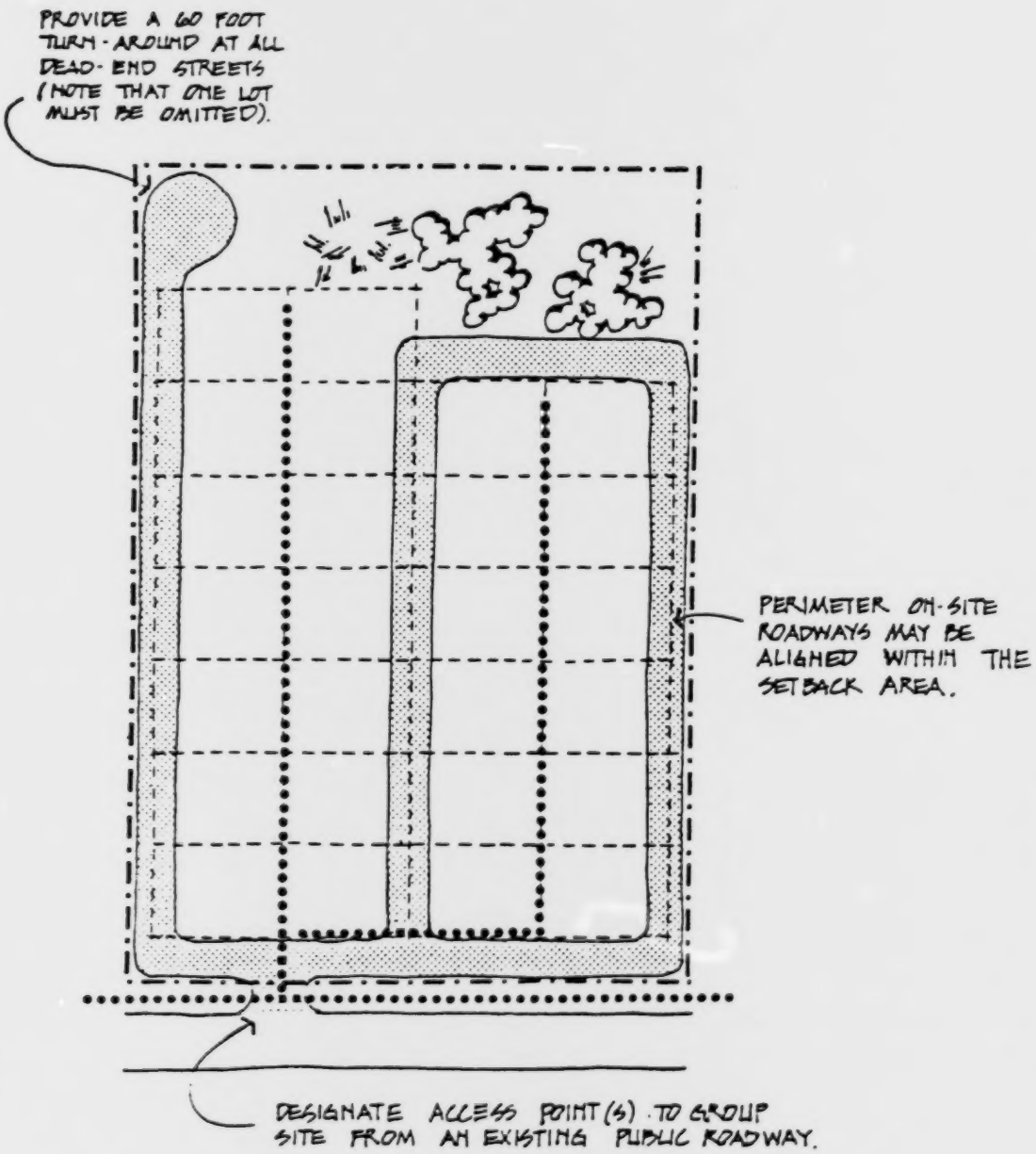
6 Lay out on-site roadways.

Provide an on-site roadway system which will give direct access to each lot, for the delivery and positioning of each mobile home unit, but will avoid conflict with the installation or maintenance of the utility layout; vehicular turn-arounds or cul-de-sacs may be incorporated.

The lot depth dimension of either recommended lot prototype provides for one-half (i.e., 12 ft.) of the overall required street width dimension (i.e., 24 ft.); therefore, the placement of two lots adjacent to each other, as shown, provides for the total internal street width dimension required. For this reason, no additional space need be provided for on-site roadways in the lot layout procedure. In summary, the roadway alignment is determined by the lot and utility layout throughout the site plan.

However, where lots have been aligned two abreast a'ong the perimeter of the site plan in order to achieve an efficient utility layout, only one-half of the required width is provided for an access roadway at the perimeter of the site. In such cases, the remaining one-half street width may be comprised of and aligned with the perimeter setback area, as indicated.

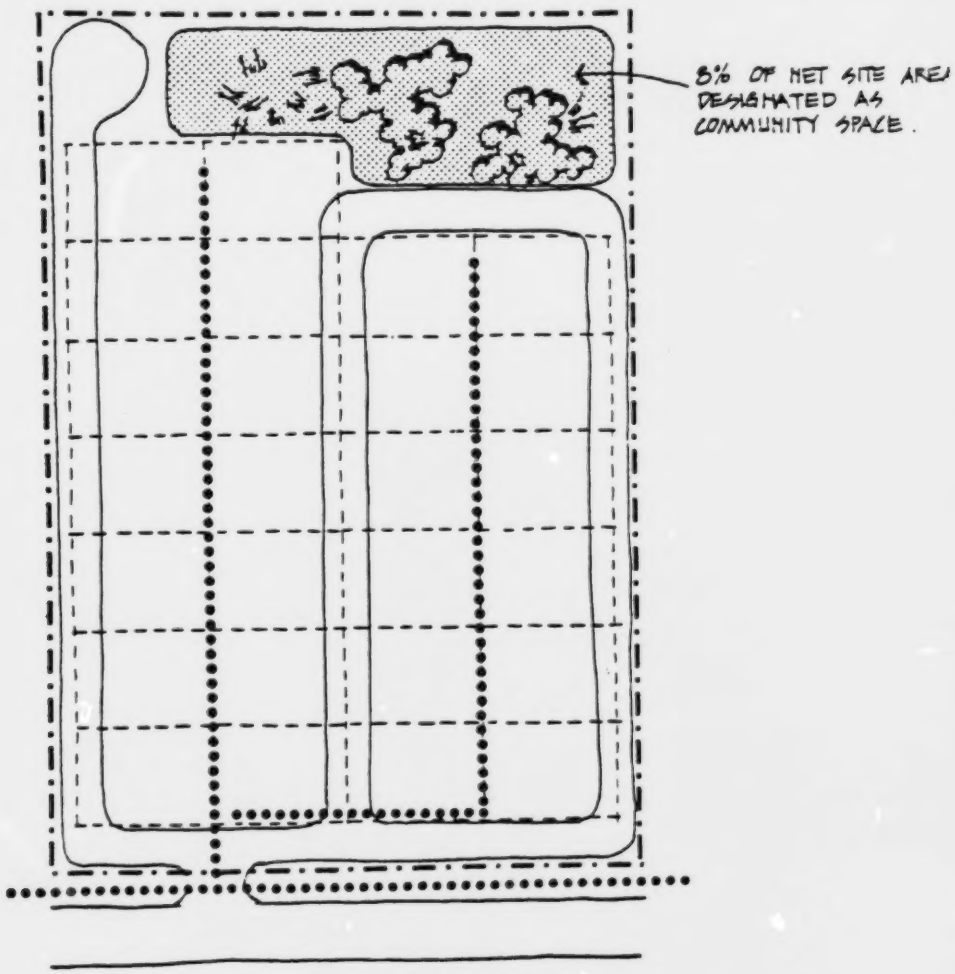
The planner should note that the perimeter roadway scheme will increase the overall length of the roadway, but will decrease the total costly linear footage of utility line required, which is most desirable and necessary in order to effectively reduce total cost.


PROVIDE A 60 FOOT TURN-AROUND AT ALL DEAD-END STREETS (NOTE THAT ONE LOT MUST BE OMITTED).
PERIMETER ON-SITE ROADWAYS MAY BE ALIGNED WITHIN THE SETBACK AREA.
DESIGNATE ACCESS POINT(S) TO GROUP SITE FROM AN EXISTING PUBLIC ROADWAY.

7 Designate community space.

Designate at least eight percent (8%) of the site area being developed as community space for group sites of more than 25 units. Centrally located and/or difficult to develop lots are appropriate for this purpose.

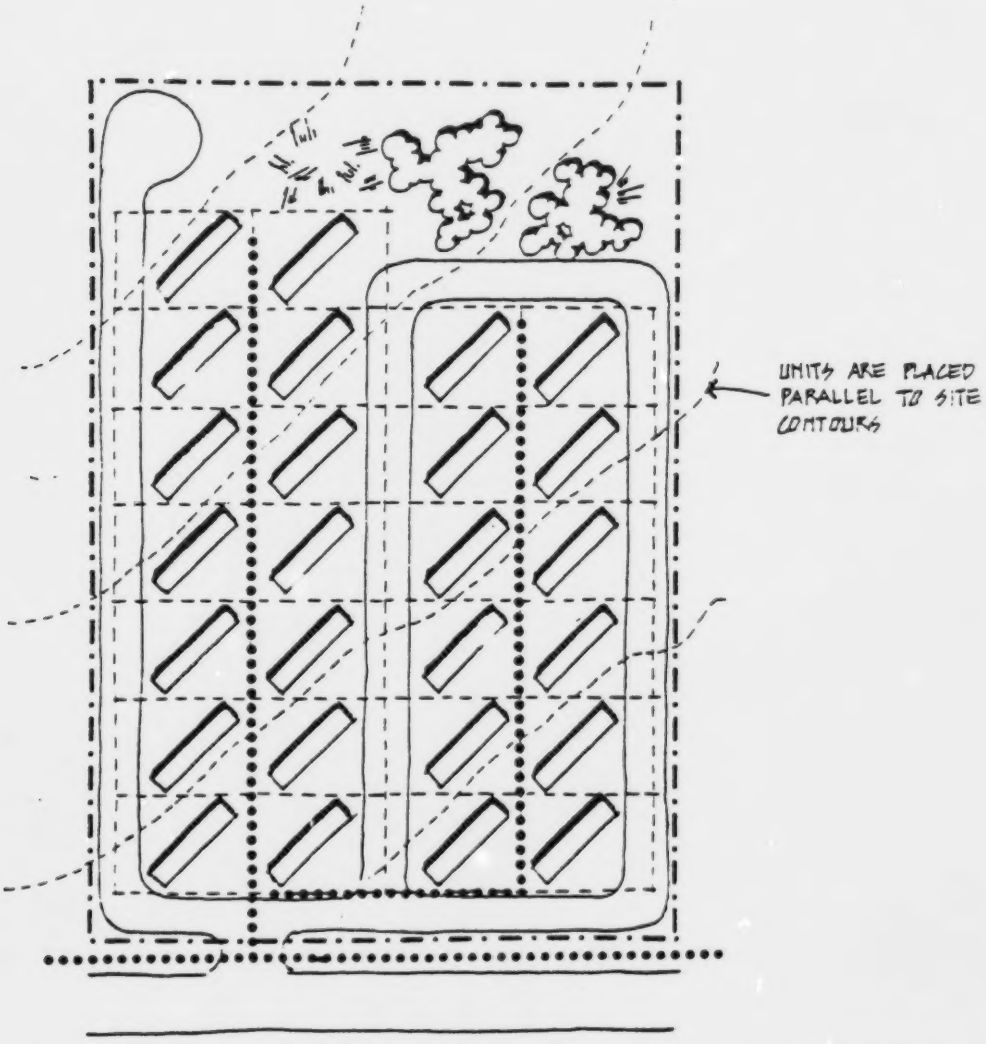
Natural site features which may be an asset to the community space should be included in the 8% designation. Guest parking and inaccessible site features such as lakes and ponds, however, should not comprise the 8% total, but should be adjacent to it.



Community space is not required when sites of fewer than 25 units are planned. Certain recommended amenities for site design, however, may be provided, such as laundry and recreational facilities.

8 Lay out mobile home units.

Lay out mobile home units on the lots using the recommended prototypical orientations in order to maintain acceptable setback and privacy standards. Dimensions given for unit setback on the lot should be observed in all cases, and units should be placed back-to-back to facilitate utility connection and roadway efficiency, as shown.



The orientation of individual units should be placed parallel to the slope of the site, sensitive to the direction of sunlight and wind, and must respect physical constraints such as trees, rocks and low lying swampy ground.

PART 2

SITING CRITERIA

CRITERIA RELATED TO FIRE PROTECTION

1. All facilities shall be sited in compliance with the minimum separation outlined in this article in order to:

a. Impede the spread of fire.

b. Facilitate fire fighting operations.

c. Meet operational building separation requirements.

2. Paragraph 4. specifies the separations to be used. Where a siting involves two facilities with different separations, the greater separation shall apply.

3. Metric values in the following Figures are not intended to be exact conversions.

4. Minimum separations for buildings and facilities are as follows: see Figure 2-1.

PARTIE 2

CRITÈRES D'INSTALLATION

CRITÈRES CONCERNANT LA PROTECTION CONTRE L'INCENDIE

1. La distance séparant tous les bâtiments de l'installation doivent correspondre au minimum fixé dans cet article de manière:

a. à empêcher la propagation du feu;

b. à faciliter la lutte contre le feu; et

c. à respecter les normes opérationnelles régissant la séparation des bâtiments.

2. Le paragraphe 4 précise quelles sont les distances devant être respectées dans chaque cas. Lorsqu'un site comporte deux installations pour lesquelles les exigences ne sont pas les mêmes, c'est la distance la plus grande qui devra être respectée.

3. Les conversions métriques figurant dans les tableaux ci-dessous ne donnent que les valeurs approchées.

4. Les distances minimums devant séparer les bâtiments et les installations sont les suivantes (Figure 2-1):

2.7.2 Army Camps/Barracks

Handbook, Siting and Airfield Zoning (.98.001.003/MS.003) National Defence, contains very general guidelines for site development of barracks type accommodation.

9 Check site density.

Divide the total number of units by the net site area being developed. An acceptable density range is six to eight units per acre; efficient disaster housing sites should contain no fewer than five units nor more than nine units per acre.

If the planner finds the finished site plan to have a poor density, of if site access, roadway layout, orientation, or other design features can be improved upon, the site plan should be revised in order to achieve a more satisfactory scheme.

$$\frac{\text{TOTAL NUMBER OF UNITS}}{\text{SITE AREA}} = \text{DENSITY}$$

$$\frac{26 \text{ UNITS}}{4.09 \text{ ACRES}} = 6.35 \text{ UNITS/ACRE}$$

Our research into past disaster housing sites revealed that many sites were built to a density range of six to eight units per acre. After reviewing historical sources and experimenting with several density ranges we concluded:

1. From an environmental and development cost perspective, a density range of six to eight units per acre yielded a livable and efficient site (i.e., cost of utility lines and roadways related to number of pads).

2. A higher density (eight to ten units per acre), necessitating a 20 ft. spacing between the units and parking spaces between units, would only be acceptable for short-term occupancy of one to three months.

An overall density range of five to ten units per acre is acceptable. A density of less than five units per acre is inefficient and economically unfeasible, and a density of 10 or more units per acre is socially and spatially unacceptable.

Item	Facility		Separation in feet (meters in brackets)
7	Transformer station Note -- Refer to Canadian Electrical Code table 38.	a. Transformer platform structure	25 (8 m)
		b. Perimeter fence	6 (2 m)
8	Flammable Stores building *See Note 1.	a. less than 200 sq ft (200 m^2) in area Fire resistive Non-combustible	 25 (8 m) 50 (15 m)
		b. 200 sq ft (20 m^1) more in area Fire resistive Non-combustible	 50 (15 m) 100 (30 m)
9	Fuelling tender parking lots		150 (45 m)
10	Parallel extension to existing building — Separation between wings *See Note 1.	a. If building 32 ft (10 m) or less in width Non-combustible Combustible	 15 (5 m) 25 (8 m)
		b. If building more than 32 ft (10 m) in width Non-combustible Combustible	 30 (10 m) 40 (12 m)
11	Married quarters	a. Detached, semi-detached and transportable houses	20 (5 m)
		b. Row houses and apartments	30 (10 m)
		c. Mobile homes (trailers) Additions and appurtenances such as porches and storage sheds shall be considered part of the Mobile Home and shall not be permitted where they would infringe on this separation.	20 (5 m)
		d. MQ and Mobile Homes to buildings outside the MQ area or Mobile Home court.	70 (20 m)

Figure 2-1 (Sheet 3 of 5) Minimum Separation for Buildings and Facilities

(Français au verso)

Item	Facility		Separation in feet (meters in brackets)
12	Garages in MQ area distance from MQ	a. 1 and 2 bay	10 (3 m)
		b. 3 or more bays	25 (8 m)
13	Parking Lot		25 (8 m)
14	Firebreaks		Refer to CFP 120 Art 4071
15	Single and multiple storey buildings *See Note 1.	a. Combustible construction	50 (15 m)
		b. Non-combustible construction	40 (12 m)
		c. Fire resistive construction	30 (10 m)
16	Garages and NPF auto clubs		80 (25 m)
17	Runway lighting APU buildings		40 (12 m)

*NOTES — 1. Building construction classification:

a. Fire Resistive — Structure is constructed entirely of non-combustible materials and will withstand for several (2 to 4) hours without structural failure the most severe fire to be expected within the building.

Details — Roof — reinforced concrete slab on reinforced concrete or protected steel structural framing.

Floors — reinforced concrete slab supported on reinforced concrete framing or structural steel, protected with (complete encasement) concrete, masonry or other materials of equal fire resistance.

Walls — brick, concrete blocks, hollow tile.

b. Non-Combustible — Structure is constructed entirely of non-combustible materials that either fail to meet the full requirements for fire resistive construction or are without fire resistance protection for the structural steel elements. As such non-combustible construction does not contribute fuel significantly to a fire originating in the contents of the building.

Details — Roof — corrugated sheet metal, corrugated asbestos, precast concrete, tile, gypsum, lightweight concrete, and insulated metal deck on structural steel framing.

Figure 2-1 (Sheet 4 of 5) Minimum Separation for Buildings and Facilities

(Français au verso)

CRITERIA RELATED TO SECURITY

10. To facilitate the maintenance of security, restricted areas should be as compact as possible and facilities requiring a high degree of security should be grouped together rather than scattered.

11. To promote economy in providing security:

a. Guardhouses should normally be sited at the main entrance to a station or site.

b. Entrances to stations or sites and to restricted areas within stations or sites should be kept to a minimum.

12. In the event that a permanent married quarters (PMQ) area is situated adjacent to a station and there is an unguarded entrance to the PMQ area from outside DND property, there should not be an unguarded means of access between the PMQ area and any guarded area of the station.

13. Restricted area perimeter fencing shall be sited at least 40 feet (15 m) from the facilities to be protected. A clear space of at least 30 feet (10 m) shall be maintained outside the fence line. Fencing must be sited in a manner that will allow efficient snow removal. The siting requirements for security fencing are amplified in CFP 128(1), article 5407.7.

14. The special criteria applicable to nuclear capable bases are contained in DNDP17(3).

15. Guidance for the siting of security lighting is outlined in CFP 128(1), article 5407.

CRITERIA RELATED TO TRAFFIC SAFETY

16. Traffic hazards should be precluded wherever possible by good design and layout of roads, walks and adjacent facilities. Several rules for design are:

a. Right angle tee intersections should be incorporated in designs wherever possible.

b. Wye intersections with angles less than 45° and cross intersections, e.g. those having four or more legs, should be avoided.

c. 150 feet (45 m) is a desirable minimum spacing between intersections.

CRITÈRES LIÉS À LA SÉCURITÉ

10. Afin de garantir la sécurité des installations, les zones à accès réservé devront être aussi denses que possible, les installations hautement sécuritaires étant regroupées et non disséminées.

11. Afin d'assurer un fonctionnement économique des installations de sécurité:

a. les postes de garde devront être normalement situés à l'entrée principale de la station ou du site; et

b. le nombre d'entrées d'une station ou d'un site ou le nombre de zones à accès réservé à l'intérieur de ceux-ci doit être réduit au minimum.

12. Lorsqu'une zone d'habitation permanente pour les militaires mariés se trouve située à côté d'une station et que l'entrée de cette zone donnant sur l'extérieur n'est pas gardée, il faut que le passage entre cette zone d'habitation et la station soit gardé.

13. Les barrières délimitant le périmètre des zones à accès réservé devront être placées à 40 pi. (15 m) au minimum des installations devant être protégées. Un espace dégagé d'au moins 30 pi. (10 m) devra être ménagé à l'extérieur de cette barrière. La barrière devra être située de manière à pouvoir enlever efficacement la neige. Les normes d'installation concernant les barrières de sécurité sont exposées dans le PFC 128(1), article 5407.7.

14. Les critères applicables dans le cas particulier des bases nucléaires figurent à la PMND 17(3).

15. En ce qui concerne l'installation de l'éclairage de sécurité, se reporter à la PFC 128(1), article 5407.

CRITÈRES LIÉS À LA SÉCURITÉ DU TRAFIC

16. Les dangers liés au trafic devront être évités dans la mesure du possible grâce à une bonne conception et à une bonne implantation des routes, des allées et des installations adjacentes. Un certain nombre de règles devront être respectées en la matière:

a. les intersections à angle droit et en forme de T devront être retenues dans les plans chaque fois que cela sera possible.

b. Les intersections en forme de y dont l'angle est inférieur à 45° ou les croisements présentant quatre branches ou davantage devront être évités.

c. La distance idéale séparant deux intersections devrait être de 150 pi. (45 m).

d. Buildings, trees, and hedges should be set back sufficiently at intersections to permit good visibility in all directions.

e. Parking facilities, wherever feasible, should be set back from roads and should have well defined exits and entrances.

f. Vehicular and pedestrian traffic should be separated as much as possible.

g. Minimum radius for roads to be 30 feet (10 m) where possible.

17. In the interest of traffic safety the basic road functions of carrying traffic and providing access to buildings should be separated as much as possible and alignment should reflect the primary function. Roads which are intended primarily to provide access should be awkward for through traffic while those intended primarily to carry traffic should be smooth flowing but only to the extent that they will not encourage speeding.

CRITERIA RELATED TO ENGINEERING ECONOMY

18. The importance of fulfilling requirements at minimum cost should be reflected in all studies related to the siting of buildings and facilities. Compact, rather than sparse layouts should be strived for in order to keep overall development costs as low as possible.

19. Some of the more important siting factors relating to engineering costs are that:

a. Areas where ground water and soil conditions would necessitate elaborate drainage systems and foundations should be avoided.

b. New facilities should be sited so that earth moving and rock excavation are kept to a minimum.

c. New facilities should be sited as close as possible to existing service mains which are large enough to carry the additional loads, and should not conflict with existing services.

d. Siting of many facilities should provide for future extensions.

e. New facilities should be sited as close as possible to existing roads.

d. Les bâtiments, les arbres et les haies devront être places suffisamment en retrait aux intersections afin d'assurer une bonne visibilité dans toutes les directions.

e. Chaque fois que cela sera possible, les voitures ne devront pas être stationnées dans la rue, mais sur des emplacements ayant une entrée et une sortie bien définies.

f. La circulation des véhicules et celle des piétons devront être séparées dans la mesure du possible.

g. Dans la mesure du possible le rayon de courbure minimum des routes devra être de 30 pieds (10 m).

17. Dans l'intérêt de la sécurité, les deux principales fonctions des routes, écoulement de la circulation et accès aux bâtiments, devront être séparées au maximum, l'alignement des bâtiments étant la règle. Les voies d'accès devront éviter la circulation alors que les routes destinées principalement à la circulation devront favoriser son écoulement sans toutefois favoriser la vitesse.

CRITÈRES LIÉS À LA RENTABILITÉ TECHNIQUE

18. Toutes les études d'implantation des bâtiments et des installations devront s'efforcer de répondre aux normes tout en limitant les coûts au maximum. Au lieu de disséminer les installations, il conviendra de procéder à une implantation dense afin de limiter au maximum les coûts de développement.

19. Voici quelques-uns des principaux critères d'implantation liés à des impératifs techniques:

a. les zones dont le sol est gorgé d'eau ou qui se présentent dans un état tel que des systèmes de drainage ou des fondations spéciales sont nécessaires, devront être évitées.

b. Les nouvelles installations devront être implantées de manière à éviter au maximum les terrassements et les excavations dans le rocher.

c. Les nouvelles installations devront être situées le plus près possible des grands réseaux d'alimentation existants, capables d'absorber les charges supplémentaires que cela représente, et ne devront pas faire double emploi avec ces réseaux.

d. Nombre d'installations devront être implantées en tenant compte des nécessités d'agrandissements futurs.

e. Les nouvelles installations devront être situées aussi près que possible des routes existantes.

2.7.3. Construction/Mining Camps

The consultant had discussions with both Energy Mines and Resources and ATCO Eastern concerning site development guidelines for camp modules. It appears that no specific standards exist.

The manufacturers design the camp layouts to meet the codes of the particular jurisdiction that it will be located in Specific requirements from the manufacturer's clients also effect the design development of specific camps.

EMR had no standards or guidelines and suggested contacting the camp module manufacturers.

PART III - BUILDING FRAMEWORKS

3.1 General Notes

There are many types of housing units that could be applicable to a temporary housing situation.

They can be divided into three major groupings.

1. Pre-Manufactured: Units that are basically complete, are in stock, and can provide finished living accommodation.

2. Renovate/adapt existing structures: Using existing building stock and renovating it to provide temporary housing units. This could also include the modification (physical & social) of existing housing units to provide higher occupancy densities.

3. On site new construction: Units that would be built on partical site using available materials & techniques.

Using these groupings a review of various unit types has been carried out indicating that particular unit's appropriateness for post nuclear attack temporary housing.

The final section of this part of the study deals with existing standards & guidelines for unit design of temporary/emergency housing.

3.2 Pre-Manufactured Units

3.2.1 Recreational Vehicles

There are 4 major types:

1. Travel trailer
2. Truck camper
3. Camping trailer
4. Motor home

In the past only the travel trailer has been used by agencies providing disaster temporary housing.

The camping trailer would be inappropriate for the conditions assumed in this study as it can not provide a comfortable liveable environment in winter and it does not provide normal amenities and facilities. e.g. bathrooms, indoor food preparation etc.

The other three types could be used although they do have some drawbacks.

a) size - generally 25' x 8' - HUD felt that this area was too small for a normal family for more than 3 months 1.

b) climate control - HUD felt they could not provide adequate climatic control in winter. If adequate insulation and heat sources did exist then they could be used (some types presently used in Canadian winter). A major drawback could be the heat source. If it is electric a new source may have to be found as power supplies may be severely disrupted for long periods after a nuclear attack. 2.

c) plumbing systems - these must be pumped out regularly. If permanent hook up was made it would have to be frost protected.

d) Minimum Living Standards - these units fall below the minimum standards outlined in sector 3.5 of this report (HUD standards). However in an emergency situation people may be able to adapt to smaller space requirements.

Finally one major plus for these units is that they can be driven directly to their site by their owners and thus do not depend on other parts of the transportation network.

Site development would likely be similar to mobile home units, although on somewhat smaller lots.

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1. Abbeles, Schwartz and Assoc./Beyer, Blinder and Bell; Cost Effective Housing Systems for Disaster Relief. Vol. 4 1974 p. 107.

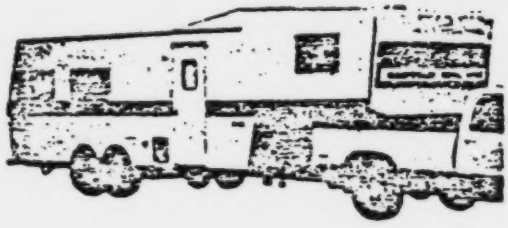
2. Sullivan, R., Guthe K., Thoms, W., Survival During the First Year After a Nuclear Attack. System Planning Corps. 1979, p. 56.

FIGURE 14

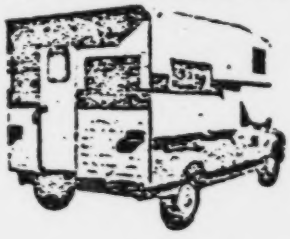
THE EIGHT SYSTEMS CURRENTLY PRODUCED BY THE RECREATIONAL VEHICLE INDUSTRY

1. TRAVEL TRAILER
   a. Regular Travel Trailer

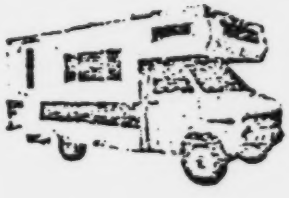
   b. Fifth Wheel



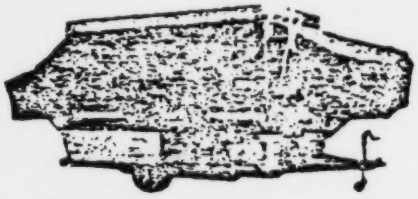
2. TRUCK CAMPER
   a. Slide-in (Pickup Cover)



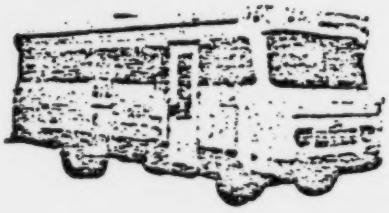
   b. Chassis-Mount Truck Camper



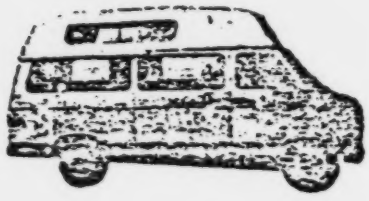
3. CAMPING TRAILER



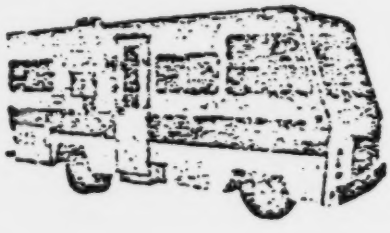
4. MOTOR HOME
   a. Regular Motor Home



   b. Van Conversion



   c. Mini-Motor Home



3.2.2 Mobile Homes

Three types:

1. Single Wide — "transportable structure which exceeds either 8 feet in body width or 35 feet in body length, built on a chassis and designed to be used as a dwelling with or without a permanent foundation when connected to the required utilities".
   83% of production of all mobile home in U.S. in 1972.[1]

2. Expandable — "an expandable mobile home is a mobile home with one or more room sections that fold, collapse or telescope into the principal unit when being transported and which can be expanded at the site to provide additional living area".
   2.2% of production in U.S. in 1972[2]

3. Double-Wide — "a double-wide mobile home is a mobile home consisting of two sections combined horizontally at the site while still retaining their individual chassis for possible future movement".
   14.8% of production in U.S. in 1972[3]

   This type of unit is basically a modular home on wheels.

HUD presently uses a rugged version of a single wide mobile home for its temporary disaster housing. They have done indepth studies on these units and these are listed in the Bibliography. This unit type was chosen by HUD because it was reuseable, cost effective, could be easily sited and provided an acceptable standard of single family accommodation.

One drawback to the use of mobile homes in a nuclear emergency is that the majority are heated electrically. This would probably have to be changed to another source e.g. propane, requiring some modifications to the unit. This of course assumes that other heating sources would be readly available, an assumption that may not be viable in a nuclear emergency.

Site development is illustrated in section 2.7 of this study.

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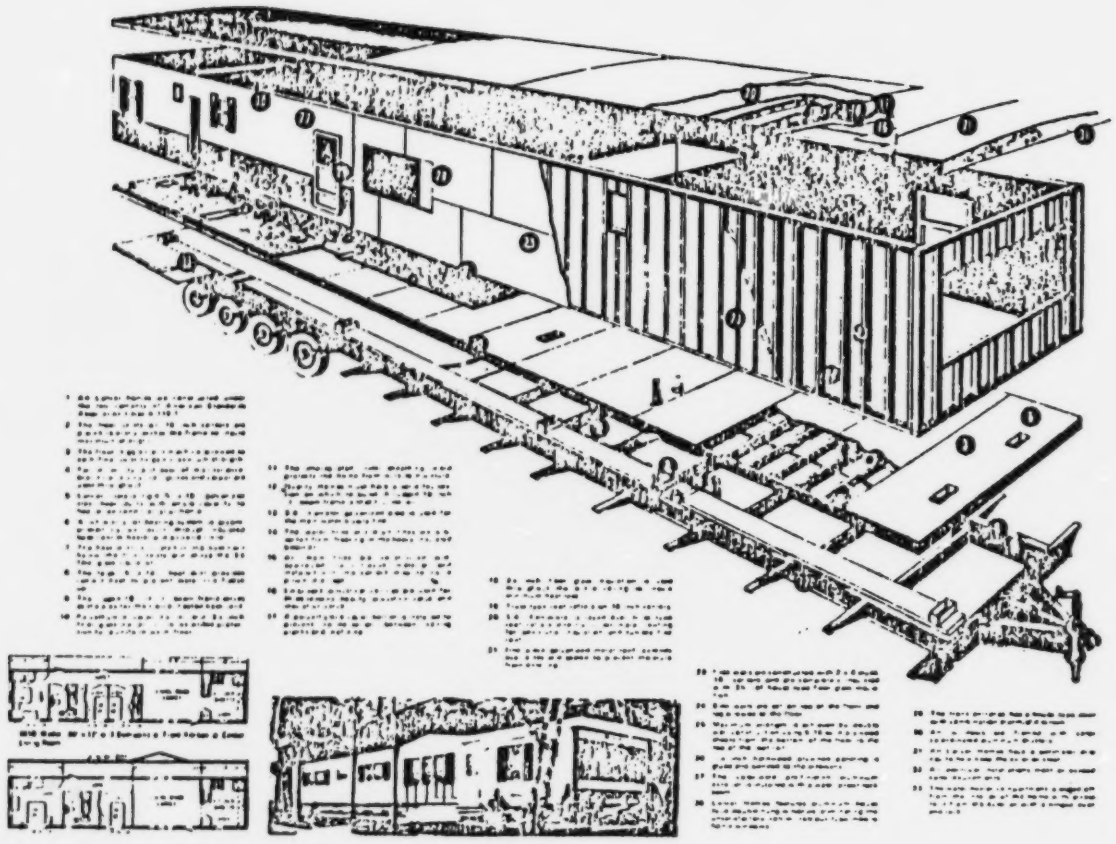
1. Abbles, Schwartz & Assoc./Beyer Blinder and Bell, Cost Effective Housing Systems for Disaster Relief, Washington, 1974, pp. 94-95.

2. Ibid, p. 97.

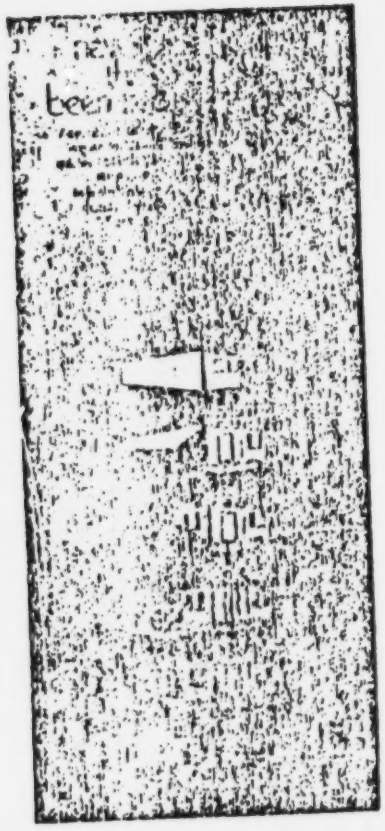
3. Ibid, p. 103.

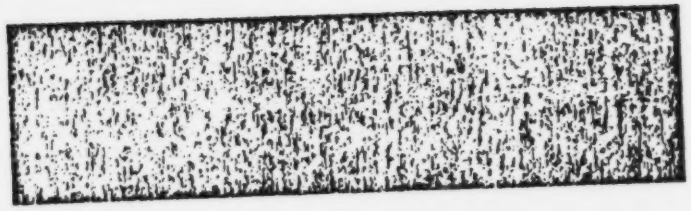


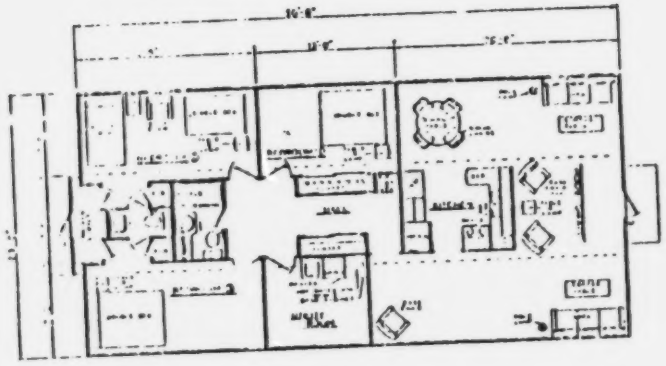
SINGLE-WIDE MOBILE HOME

Example: Lancer Homes (Lanchart Industries)

FIGURE 15



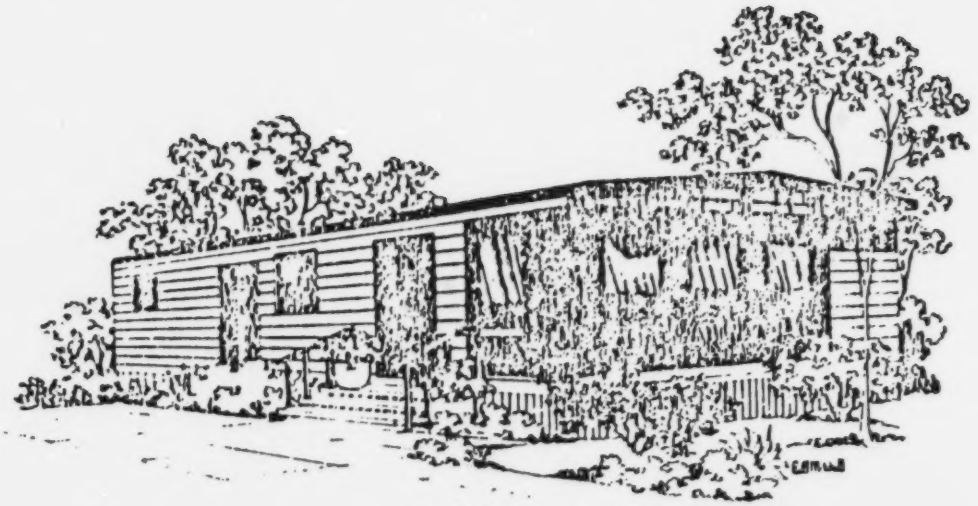




EXPANDABLE MOBILE HOME

Example: Guerdon Industries

FIGURE 17



"STANDARD" FEATURES:

- I-Beam frame with basement floor.
- Copper tubing for fresh water system.
- Outside water heater door.
- Electrical systems conform to Nat'l Electric Code.
- Prefinished, fitted cabinet doors with self closing hinges.
- Plumbed for washer.
- Hollow-core, swinging passage doors.
- Full length, closet doors in all bedrooms.
- Tough, chip resistant acrylic tub and sink in bathrooms.
- 24" surface mounted bath cabinet.
- Stainless steel sink.
- Full fiber glass insulation.
- Floor joist, wall studs and truss type rafters all on 16" center or less.

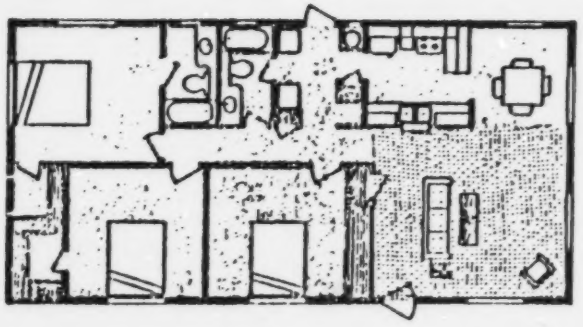


FIGURE 18

DOUBLE-WIDE MOBILE HOME

Example: Champion Home Builders

3.2.3 Camp Modules

Camp systems have been developed to service the housing needs of companies involved in remote/temporary operations, especially oil exploration, drilling, mining and construction.

The system is basically a wood frame box 8' - 12' wide x 8' high x 24' - 50' long. These units contain various functions - sleeping quarters, dining areas, washrooms, recreation lounges etc. The units either come as a completely constructed box on steel chassis or a knockdown package of floor, wall sections and roof, which is site assembled.

Units can be heated with either gas or electricity. They require underground utility lines (water & sewer) and central treatment plants. In remote locations sewage treatment is either septic field, modified septic field or lagoon settlement ponds.

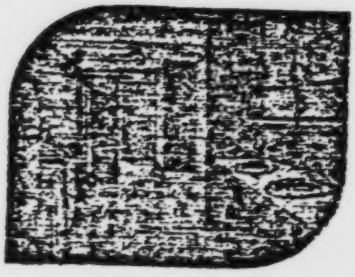
Because of their design for northern energy campus etc. the camp module is ideally suited to the Canadian climate and would serve well as temporary housing for both singles and families (family accommodation may require slight interior modifications).

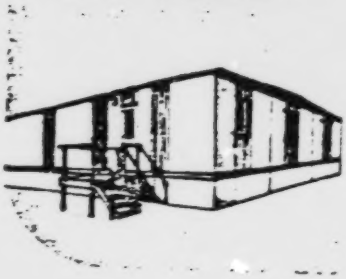
The major draw back to their utilization in a nuclear crisis situation is that few units are stockpiled. The production line is utilized to produce ordered units. With high financing costs, units cannot be stockpiled for future orders. A further complication is the location of the majority of existing units i.e. remote areas; areas that would probably not be accessible to evacuees. This could be overcome by transportation of units to evacuee centres after an attack but only if adequate transport & fuel facilities exist.

Appendix B contains a number of unit plans as produced by ATCO Ltd., a Canadian manufacturer of this unit type.

standard features
Aluminum sliding windows. 2 Oil, forced air, gun burner type furnaces thermostatically controlled c/w in floor heat ducts. Incandescent lighting. Insulated walls, ceilings and floors. Light fixtures beside exterior doors. Heavy duty hitch and leveling stand. Electrically approved by CSA. One piece floor covering 0.080 gauge. Wall mounted bunk lights. Washroom c/w: 220 CFM ceiling mounted venting fan. One 50 gallon oil water heater. Two showers. Two water closets. Four sinks. One urinal. Four mirrors. One laundry tub. Ten night tables. Twenty clothes closets.

optional equipment & furnishings
Mirrors 14" x 16". Coat hook boards c/w 4 hooks each. 36" x 78" continental beds c/w mattresses. Curtains 42" x 48" c/w rod. Linen closets. Vestibule doors. Easy chairs. Stack chairs. Washer and dryer. Complete fire alarm system. Tridem axle running gear c/w electric brakes. Heavy duty, 8-14.5 12 PLY rated nylon tires, and wheels. Waste baskets.





standard technical specifications:

floor
¼" under sheathing. 2" x 6" joists at 16" o.c. 3" fiberglass insulation c/w vapour barrier. ⅝" plywood sub-floor. In-laid vinyl one piece floor covering. U-factor is 0.078.

walls
30 gauge prefinished metal siding beige with yellow feature panels. 5/16" plywood sheathing. 2½" fiberglass insulation friction fit. 2" x 3" studs at 16" o.c. 2 mil polyethylene vapour barrier. 4mm prefinished wall paneling colour coordinated in bedrooms and corridors. 4mm vinyl covered colour coordinated wall paneling for ease of maintenance in washroom. Black baseboard. U factor is 0.10. Partition framing is 2" x 2" at 16" o.c. Black gymp moulding.

roof
30 gauge galvanized steel one piece. 5/16" plywood sheathing. 2" x 6" rafters sloped to 2" x 4" at 16" o.c. 2" x 8" rafter crowned to 2" x 6" at 16" o.c. 4" fibreglass friction fit insulation. 2 mil polyethylene vapour barrier. ½" fibreboard with imprinted design. U-factor is 0.06.

doors
Exterior: thick metal construction c/w lock, colour coordinated with interior and exterior finish. Door size is 30" x 80".
Interior: thick hollow core wood construction 30" x 80" c/w lock. Colour coordinated with interior finish. Comes with master key set for maintenance force.

windows
30" W x 40" H aluminum horizontal sliding. Double glazed c/w vinyl thermo break and screen.

hitch
Welded on "A" frame c/w lunette eye and parking leg.

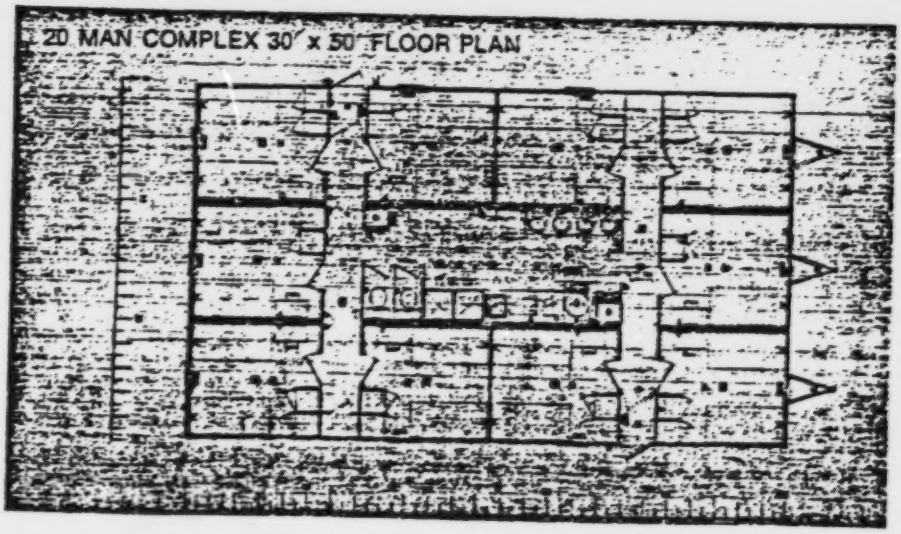
frame
Main members are 8" channel. Frame is coated with rubberized black paint.

electrical
115/230 volts, single phase, 3 wire, 60 cycle. Comes complete with mast, meter base and power panel. All wiring is concealed. Approved by CSA. Nominal power requirement is 15Kw.

plumbing
All fixtures, fittings and piping is CSA approved. The water supply system is designed for a maximum supply pressure of 80 P.S.I.
Oil line stub out is ½" ø black steel pipe. The water line is 1" ø copper pipe. Sewage discharges are 3" ø and 2" ø ABS.
The height of the outside units on running gear from ground level to roof level is approximately 10'8". The core unit is approximately 10'10".

The information contained herein was in effect at the time of printing this folder, however because of continuing product improvements and refinements, ATCO reserves the right to discontinue or change specifications, design and prices without notice and without incurring obligations.

SERVICE ENTRANCE MAST
MAIN POWER PANEL
SUB PANEL
INCANDESCENT FIXTURE
EXTERIOR LIGHT
BUNK LIGHT
INTERIOR WALL MOUNTED FIXTURE
SINGLE POLE SWITCH
3 WAY SWITCH
FAN SWITCH
FURNACE SWITCH
SPECIAL RECEPTACLE
DUPLEX RECEPTACLE
RAZOR OUTLET
WEATHER PROOF RECEPTACLE
240 V OUTLET
120 V OUTLET
CEILING MOUNTED FAN
THERMOSTAT
FIRE DETECTOR
FIRE ALARM BELL
FIRE BREAK GLASS STATION
FIRE ALARM CENTRAL STATION

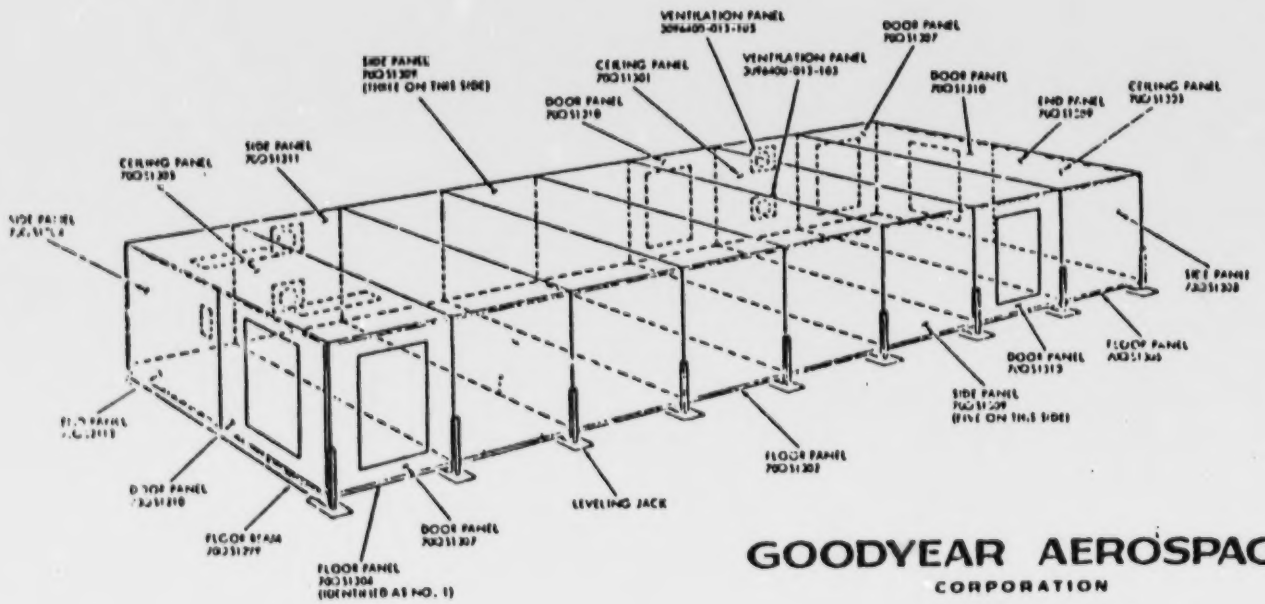


3.2.4 Special Relocateables

These systems were developed for the U.S. armed forces in the early 1970's. They are all prototypical and they have not gone into major production.

They have been included for interest but are not applicable to the Canadian situation other than for future reference and study re:construction & siting techniques.

FIGURE 28
MODULAR PROCESSING AND SUPPORT SYSTEMS (MPASS)



GOODYEAR AEROSPACE
CORPORATION
ARIZONA DIVISION
LITCHFIELD PARK, ARIZONA 85340

MODULAR PROCESSING AND SUPPORT SYSTEMS

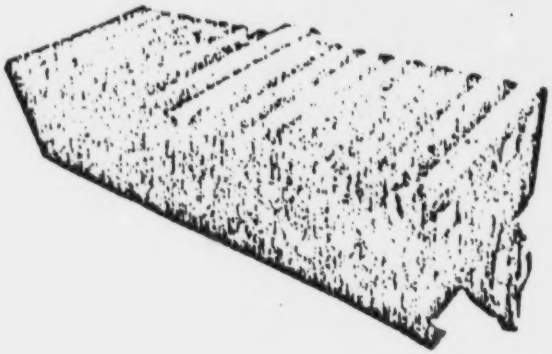
FIGURE 29
EXPANDABLE PERSONNEL
SHELTER (EXP)

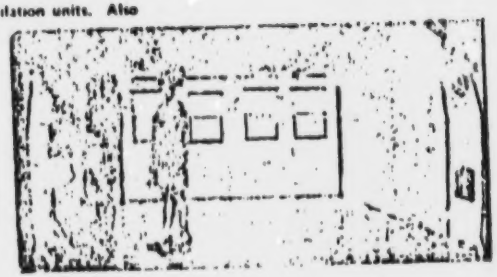
MODEL EXP SHELTERS

Shipping Mode
2 ft 8 in. x 13 ft x 8 ft

Deployed
13 ft x 32 ft

- Provides more than 400 square feet of clean, well lighted living or work space for:
  - Single-family living unit
  - Dual-family living unit (with center divider wall)
  - Administrative office
  - Dining area
  - School room
  - Child care center
  - Volunteer crew barracks
  - First aid, pharmacy, or hospital ward
- Can be erected in less than one hour on unprepared surface.
- Nine units (nine to 18 family emergency units) can be transported on one 40-foot flat bed tractor/trailer.
- 60 cubic feet of container volume available within folded shelter for cots, tables, chairs, or other furnishings.
- Designed for operation in 80 knot winds (90 knot gusts). Suitable for tropic to arctic conditions.
- Contains integral electrical wiring for lighting, convenience outlets, and heater/ventilation units. Also includes exterior area lighting.





GOODYEAR AEROSPACE
CORPORATION
ARIZONA DIVISION
LITCHFIELD PARK, ARIZONA 85340

3.2.5 Miscellaneous Systems

This category covers a wide variety of systems, domes, disaster housing systems such as Descon Rombi Housing System, portable multi purpose modules etc. Because of their limited supply (in some cases only prototypes) they would have little impact on temporary housing after awide scale nuclear attack.

3.2.6 Manufactured Housing

1. Packaged - manufactured components e.g. walls, roof, trusses etc., that are site assembled.

2. Modular - usually 2 piece complete single family home joined on site prepared foundation.

This type of unit provides a finished single family home. However, for the temporary housing requirements of this study they would probably be too large (energy consumption) and too permanent (social goals of rebuilding damaged areas).

Existing stock could be used for infill but should not be used to build new permanent communities unless population is to be permanently relocated.

Factory facilities if outside blast areas could be used to build components for other types of more appropriate temporary housing. After production of adequate quantities of temporary units, production could return to production of permanent housing for blast areas.

Buy a better home for your money . . .

Quality Lumber Products

- Only the BEST lumber is selected for use in Boise Cascade Homes
- After sorting and grading, lumber is kiln-dried for strength and dimensional stability at Boise Cascade mills

Special Construction Techniques

- Full length headers over all doors and windows
- Exterior sheathing over wall studs — nailed AND glued for extra strength
- Insulation in walls and ceilings (floor insulation in electrically heated homes)
- Interior walls are smooth conventional, painted sheetrock
- Weatherstripped weather stripped doors and aluminum framed windows
- From start to finish, each phase of construction is closely inspected to maintain highest quality control
- Construction is not affected by adverse weather conditions. House is completely framed in and weather tight before it goes outside for interior finishing

A Completely Finished Home

- All appliances and fixtures installed
- All carpeting with foam pad and linoleum installed
- Electrical wiring, gas outlets and plumbing fixtures all installed and ready for hook up
- All interior and exterior painting and staining is done
- You select your own color scheme throughout

Boise Cascade Homes

Boise Cascade reserves the right to change specifications and options, and floor plans and color to designs and model plans without notice.

"Standard" Specifications

- All lumber kiln dried
- ½" Plywood sub floor, glued and nailed to joists
- Underlayment 5/8" particleboard, throughout
- Plywood sub siding, glued and nailed to studs under lap siding
- Engineered roof trusses
- Wall insulation, R-11 (3" nominal) with vapor barrier
- Ceiling insulation, R-30 (10" nominal)
- Floor insulation, R-19 (6" nominal)
- Insulated metal exterior doors
- Sliding aluminum windows, dual glazed with screens
- 2 Freeze-proof exterior hose faucets
- Radiant ceiling panel heat
- Plastic and copper plumbing
- Fiberglass tub and shower combination (w/rod)
- Glass lined electric 52 gallon water heater
- Stainless steel kitchen sink
- Ceiling light in kitchen
- Vent fan in attic fan
- Heat/light/fan in each bathroom
- Built in electric range, hood and fan
- Electrical receptacle for clothes dryer (non basement models)
- Plumbing rough in for washer (non basement models)
- Adjustable linen shelving
- Wardrobe doors, Bi-Fold
- Vanity mirrors and medicine cabinets
- Carpet in living room, hall, bedrooms, dining and family rooms
- Resilient floor covering in kitchen, baths, storage and utility rooms
- Off white interior paint, semi-gloss latex enamel
- Exterior latex paint or stain
- Textured drywall interior
- Door chimes
- One year warranty

"Standard" Options

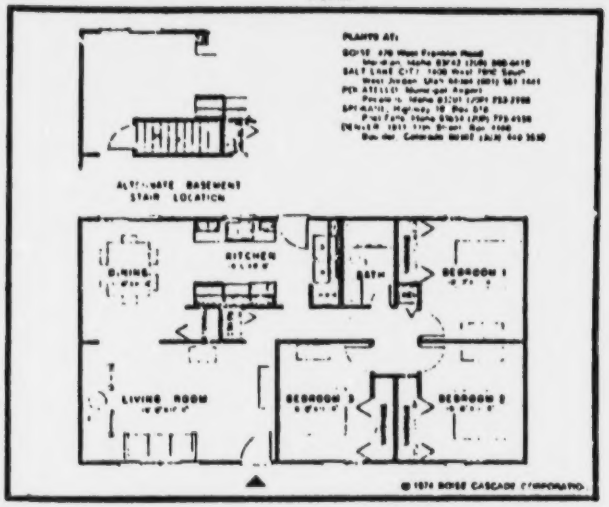
- Forced air gas heat
- Gas water heater
- Roof design for heavy snow load
- Outside weather proof electrical receptacle
- Hand split shake roof
- Fireplace
- Refrigerator, disposal, dishwasher, washer, dryer

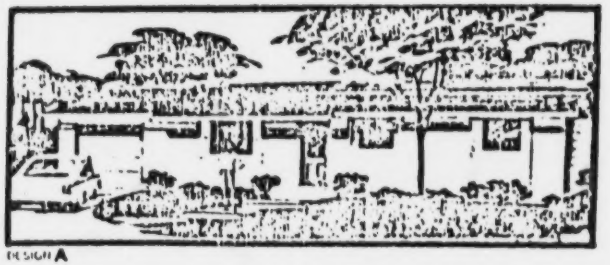
*The F.O.B. prices below include the following optional items in addition to the standard specifications above:

Refrigerator, 11 cubic feet — $200
(Prices supplied by manufacturer)

Boise Cascade Homes — the Sunnydale

1045 SQ. FT.
2 BEDROOMS
1 BATH





DESIGN A

3.3 Renovate/Adapt Existing Structures

There are a number of types of existing buildings that could be renovated to provide temporary housing over a one to three year period. These include warehouses, barns, arenas, sports facilities, theatres etc. Obviously if they were to be used and to be put into operation quickly, the conversions would require deviations from the National Building Code. In a crisis situation this would appear to be acceptable. However building experts should still inspect these conversions to avoid hazardous situations. ATCO? (prefab warehousing manufacturer) presently is adapting some of its foldaway metal warehouses for the New York prison service.

Another form of adaption would require increasing densities of existing housing. In the United States Civil Defense Plan this is proposed as the main method for housing evacuees from blast areas. The U.S. plan envisages densities 2 to 4 times existing (.6 people/room, presently).[1] No studies could be found on the social effects this type of crowding would produce over the reconstruction period. However, U.S. authorities seem to assume that it would be inconvenient, but as these standards presently exist in countries such as the Soviet Union, Poland, Greece, and India that the U.S. population could indure them on a temporary basis. The consultant feels more study should be done in this area before adopting this method.

It would appear that to provide effective integration into existing communities, shelter as quickly as possible, and with the use of as few materials as possible, that adaption of existing structures should be the first means to investigate in an emergency situation.

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1. Sullivan, R.; Guthe, K; Thoms, W.; Survival During the First Year After a Nuclear Attack, System Planning Corp, 1979, p. 133.

3.4 On Site New Construction

After the use of existing pre-manufactured stock and the adaption of existing sturctures, if a need for further accommodation is required it would be provided by construction of new units. These units would have to be built of locally available building material stock and local labour skills.

The types of units possible could include.

1. barracks
2. single family detached
3. single family semi detached
4. row housing
5. walk up apartment units

If the assumption of non permanent communities is agreed to (see Social/Cultural Impact Section 2-5) and to try to optimize the local materials and labour pools it would appear that barracks type accommodation would be the best avenue to follow. This accommodation could provide separate units for families or combined quarters for singles. Fire separation standards of units may have to be modified.

Construction would probably be wood frame or concrete block and one or two storeys. No existing information could be found on this type of unit. Existing Canadian Forces barracks are 3 storeys constructed of concrete block walls and concrete floor systems. They would require more skilled labor forces and mechanization than might exist in the majority of communities after a nuclear attack.

See section 3.5 for army area standards for barracks accommodation.

3.5 Existing Standards

During the literature search a number of area standards for temporary accommodation were found. They vary somewhat but give a general "feel" for the requirements involved. They were developed for localized emergency disaster situations. In a national nuclear attack emergency they may be too lavish or impossible to attain.

3.5.1 HUD Disaster Housing (mobile home type units).

Room	Min. Area	Min. Width	Min. Height
Living room	115 sq.ft.	9'6"	7'3"
Dining room (combine with kitchen or living room)	58 sq.ft.	6'10"	7'3"
Kitchen	57 sq.ft.	6'0"	7'0"
Bath	32 sq.ft.	4'6"	7'0"
Bedroom with double bed or 2 twin beds	68 sq.ft.	7'6"	7'0"
Bedroom with single bed or bunk beds	41 sq.ft.	6'3"	7'6"

Min. livable area for 2 bedroom unit - 500 sq.ft. ($46.5m^2$)
Min. livable area for 3 bedroom unit - 580 sq.ft. ($53.9m^2$)

Reference: Abbles Schwartz & Assoc./Beyer, Blinder and Bell; Cost Effective Housing Systems for Disaster Relief. vol. 4., 1974, p. 76.

These standands were developed from Federal Housing Authority Minimum Livability Standards. See appendix A for diagrams of these standards. These standards would allow approximately 96 to 125 sq.ft./person and are based on single family occupancy of each unit.

3.5.2 Health and Welfare, Canada. Emergency Health Services Division

Space and Sleeping Arrangements:

40 sq. ft. of sleeping space if ceiling is at least 8 feet, per adult

30 sq. ft. of sleeping space if ceiling is at least 8 feet, per child.
6 feet should be allowed between heads of beds (from centre to centre), otherwise they should be arranged head to foot
150 sq. ft. of lounging area per 20 persons (a bonus when available)
1 drying room per 30-40 persons or facilities for drying wet clothes, diapers, etc.

Ventilation:

Windows open at the top to avoid draughts
Temperature between 60-70°F
Relative humidity 30-70 per cent
2 air changes in the rooms per hour

Sanitation for 100 Persons:

5 toilets
6 wash basins (with running water if possible)
10 gallons of water per day per person

3.5.3 Canadian Forces Accommodation Scales for Single Members. (Barracks)

Rank	Bedroom (sq ft)	Plumbing and other Fixtures
Officer	100	Bathtub with shower head Lavatory basin Medicine cabinet with mirror WC
Warrant Officer and Sergeants	180 (Bedsitting room)	Bathtub with shower head Lavatory basin Medicine cabinet with mirror WC
Corporals and below	145 per person single(1) 100 per person double(2) 80 per person dormitory(3)	Aside from lavatory basin, medicine cabinet with mirror, and WC normally provided for single and double occupancy, washrooms as shown below.
	Notes: (1) For personnel other than recruits and trainees. (2) Normally, for personnel on training courses. (3) Recruits only.	Washrooms (Male) Bathtubs 4 % of number housed (with shower heads) Showers. 10 % of number housed Lav basins with mirrors 25 % those in dormitories

4 % those in single
or double rooms
WCs.
10 % those in dormitories
Urinals.
6 % those housed
Electric Water Cooler.
1 per 60 persons
Washrooms(Female)
Bathtubs (with shower
heads)
10% those housed
Showers.
5 % those housed
Lav basins and mirrors
25 % for domitories
4 % for single or
double rooms
WCs.
18 % for dormitories
Electric Water Cooler
1 per 60 persons

Reference: Canadian Forces Health
Manual CFP 213.

3.5.4 U.S. Defence Civil Preparedness Agency

(short term emergency standards).

concregate lodging spaces	40 sq.ft/person
fallout shelter space	10 sq.ft/person

reference: Wright, M.; York, S.; Development of Shelter use Plans.
Research Triangle Inst. 1979.

3.5.5 ATCO Camp Modules. (single quarters)

Sleeping quarters: 2 men/100-120 sq.ft. (no washrooms included)
washroom requirements: as per National Building Code.
Dining Facilities 15-21 sq.ft./person
(including Kitchen area)
Recreation: no standards - estimated by type of equipment client
wishes.

PART IV - FUTURE STUDY RECOMMENDATIONS

This study has reviewed a quantity of existing literature dealing with the provision of temporary emergency/disaster housing and its application to a post nuclear attack situation. It has also reviewed the very limited material dealing specifically with post nuclear attack housing. A partial series of guidelines for development of post nuclear attack temporary housing have been identified based on the assumed attack scenario developed at the outset of the study.

However as a result of this review process a number of deficiencies in both basic assumptions and existing data were identified. The following list contains a series of future study recommendations that will help to ratify these deficiencies:

1. Any future study must be undertaken in light of a co-ordinated Canadian Civil Defence Plan. A realistic scenario or scenarios of the results of a nuclear attack must be established. The plan doesn't have to be worked out to the final detail but it must define major goals, methods and strategies. This plan must be confirmed by imperical data of the existing situation not by assumptions. As an example one cannot recommend or choose a housing system, temporary or permanent, without knowing the numbers to be housed and the materials and methods available. Only a detailed attack scenario can provide this data.

   The need for this type of detailed scenario has been identified as a result of study of the U.S. system which varies dramatically from the scenario assumed at the outset of this study. The U.S. scenario appears to have been founded on a much larger number of background studies than was used to develop the assumed scenario for this study.

2. Thorough review of all U.S. Civil Defence documentation on nuclear attack housing. This will probably require meetings and discussions with U.S. officials (a request for a bibliography of U.S. information has been initiated.)

3. Review European documentation particulary Swiss and Swedish. Both these countries have highly sophisticated civil defense systems and climatic conditions similar to Canada. Could start with embassy contacts and proceed from there.

   Recommendations 2 and 3 should be carried out as a general review of how their plans propose to handle housing after a nuclear attack and then identify specific topics for future study.

4. Develop a scenario of what would be left after a nuclear attack. i.e. what supplies, skills and facilities would be intact that could be used to provide housing (both temporary and permanent) for the remaining population.

This would include the following areas:

a) inventory of existing building supply warehouses and stock piles in non target areas.

b) inventory building products manufacturers and normal stock piles outsides target areas.

c) inventory of existing pre-manufactured housing units and manufacturing plants outside target areas and estimation of their availability for use.

d) estimation of skilled or non skilled workmen and their distribution.

e) estimation of use of transport system, electrical system, energy supply systems.

5. Research effects of nuclear fallout on buildings, decontamination methods, shelter methods and design guidelines to reduce impact. U.S. studies indicate at least as many people will die from fallout radiation as from the blast effects of nuclear attack.

6. Research the social effects of crowding in various housing types, i.e. what housing densities could our society handle. As an example is the United States figure of 4 times existing density realistic.

7. Develop a housing plan for the post nuclear attack period. This may or may not entail designing new unit types and site plan layouts; but it will at the very least produce documentation to assist civil defence agencies in housing the surviving population.

8. After the adoption of an overall housing plan the following types of documentation may be required:

   a) methods of adapting various types of buildings to both fallout shelters and temporary housing. This could include: identifying suitable types of buildings, example conversion layouts, directives for adaption - structural, environmental, psychological etc.

   b) Site guidelines and layouts for various types of premanufactured units if early studies indicate there will be sufficient useable quantities and that their use would be appropriate.

   c) develop unit plans and site development guidelines for new temporary housing.

   d) types of social and physical amenties that may be required ie. temporary schools, community meeting areas, recreational facilities. Develop plans for their provision.

All the above study recommendations should only be carried out after consultation with all other agencies involved in the Canadian Civil Defence establishment.

To design any housing system without knowing the parameters can produce bad solutions. To design a post nuclear attack housing plan without the parameters could be disasterous. The very survival of our society could depend on that plan. Therefore decisions concerning its creation should be very carefully considered.

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Gilby, W., CPT., Property Division, National Defence Headquarters.	996-1897
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Mason, Guy, Senecal, Pierre, ACTO Eastern, 7213 Cordner Lasalle Quebec.	514-363-4430
Wheeler, C., Architectural Division, Energy Mines and Resources.	996-0825

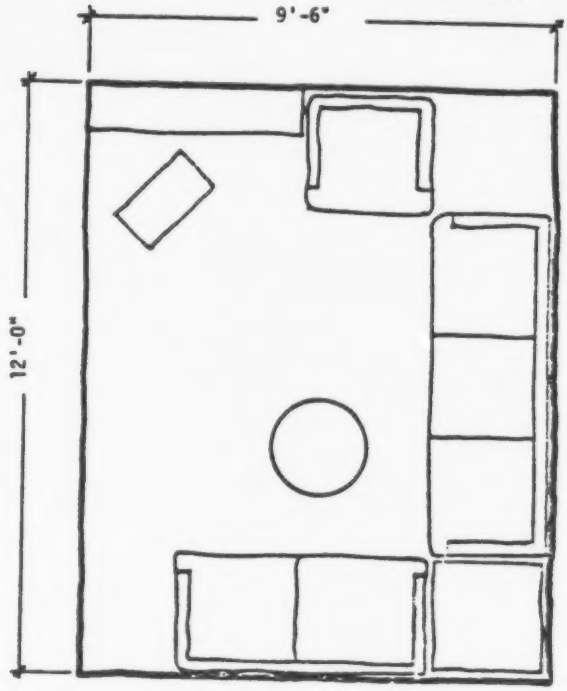
APPENDIX A. HUD Minimum Livability Standards.

FIGURE 5
MINIMUM LIVABILITY STANDARDS
LIVING ROOM

Storage:
Built-in shelving 41.f.
T.V. on stand

Seating for 6:
1 couch 7'-0" x 2'-6"
1 love seat 5'-0" x 2'-6"
1 side chair 2'-6" x 2'-6"

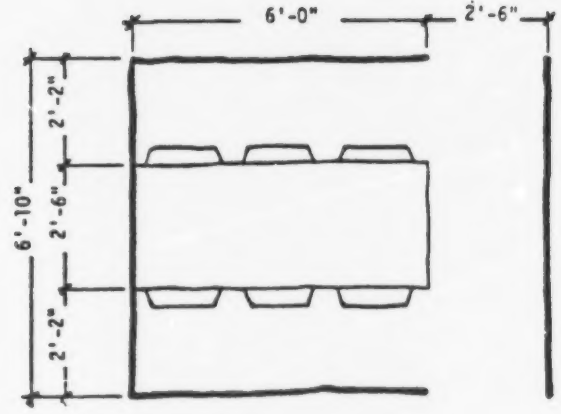
Tables:
1 side table 2'-6" x 2'-6"
1 coffee table 15"diameter



LIVING ROOM
9'-6" x 12-0"
114 sq.ft.

FIGURE 6
MINIMUM LIVABILITY STANDARDS
DINING AREA 1

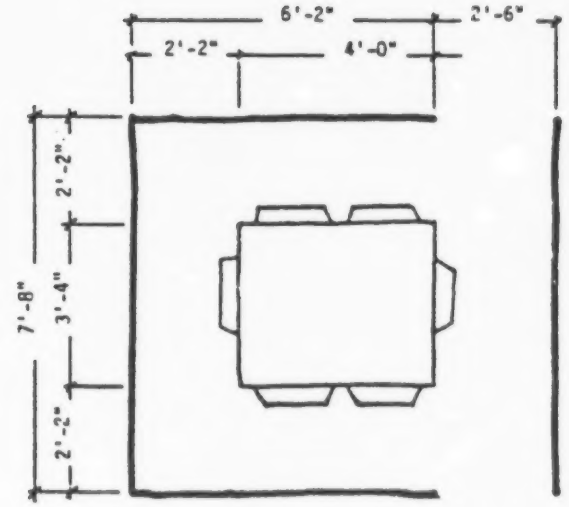
Furnishings:
Table 2'-6"x6'-0"
6 Chairs



DINING 1
6'-10" x 8'-8"
58 sq.ft.

FIGURE 7
MINIMUM LIVABILITY STANDARDS
DINING AREA 2

Furnishings:
Table 3'-4" x 4'-0"
6 Chairs

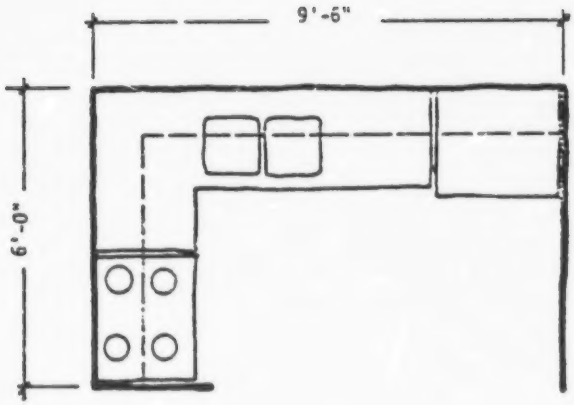


DINING 2
7'-8" . 8'-2"
66 sq.ft.

FIGURE 8
MINIMUM LIVABILITY STANDARDS
KITCHEN

Appliances:
4-burner range w/oven 30"
double sink 2'-8"
refrigerator 14 cu.ft. 2'-4"

Storage:
minimal shelf area 44sq.ft.
minimal drawer area 10sq.ft.
41f. clear counter



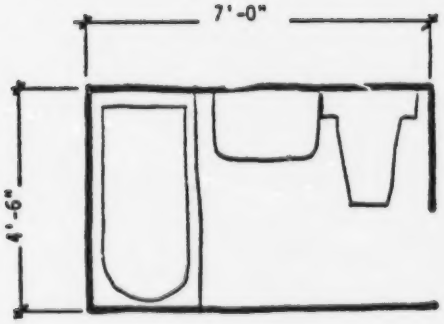
KITCHEN
6'-0" x 9'-6"
57sq.ft.

FIGURE 9
MINIMUM LIVABILITY STANDARDS
BATHROOM

Fixtures:
- 1 lavatory
- 1 commode with top and seat
- 1 tub/shower and curtain

Accessories:
- 1 hamper
- 1 tumbler & toothbrush holder
- 1 soap dish
- 1 toilet paper holder
- 1 towel bar
- 1 medicine cabinet

Storage:
- cabinet under sink

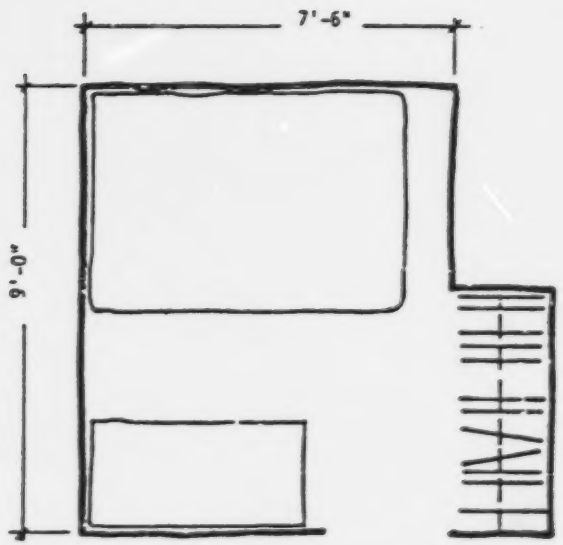


BATHROOM
4'-6" x 7'-0"
31.5 sq.ft.

FIGURE 10
MINIMUM LIVABILITY STANDARDS
MASTER BEDROOM

Beds:
1 double bed 4'-6" x 6'-6"
1 crib 2'-4" x 4'-5"or
1 desk 2'-0" x 4'-0" or
1 free-standing chest

Storage:
1 chest (built-in)1'-10"x5'-0"
1 closet 2'-0" x 5'-0"



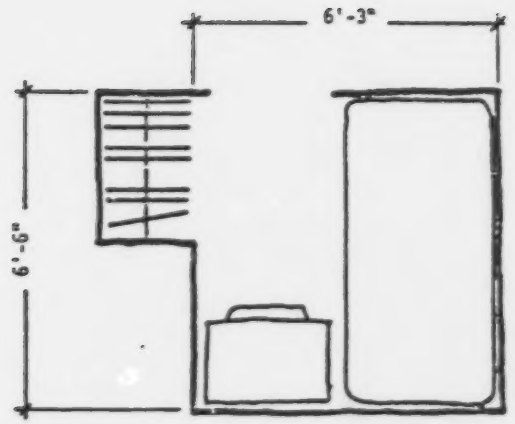
MASTER BEDROOM
7'-6" x 9'-0"
68 sq.ft.

FIGURE 11
MINIMUM LIVABILITY STANDARDS
SECOND BEDROOM

Beds:
1 bunk bed 3'-3" x 6'-6"
or 1 single bed

Storage:
1 chest (built-in) 3'-0"x1'-10"
1 closet 2'-0" x 3'-0"
1 desk 1'-6" x 2'-6"

Chairs:
1 desk chair 1'-6" x 2'-6"



BEDROOM
6'-3" x 6'-6"
41 sq.ft.

APPENDIX B. ATCO CAMP MODULES.

ATCO

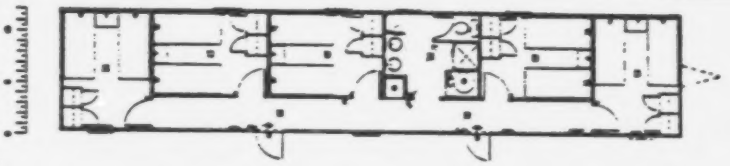
Sleepers

10 Man sleeper washcar.
20 Man complex.

Purchase or rent
for immediate delivery.

Size
12' x 60'
10 Man sleeper washcar

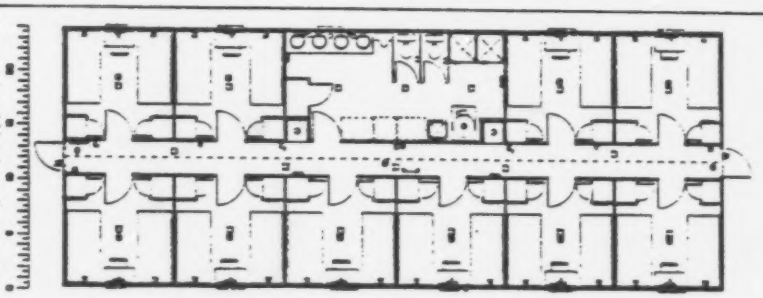
Model
1210-1



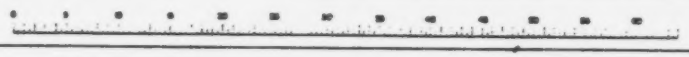
10 Man.
1 Nominal power requirement 6 6 Kw
2 Oil heat furnace
3 32 gal oil water heater
4 Steel toilet partition
Complete washroom with shower, urinal 2 sinks and mirrors
5 220 CFM ceiling mounted fan in washroom
6 Night tables and clothes closets
7 Wall mounted bunk lights
8 Complete fire alarm system
9 Coat hook boards
10 Continental beds c w mattresses
11 Curtains c w rod
12 Stacking chairs
13 Mirrors

Size
24' x 64'
20 Man complex

Model
2464



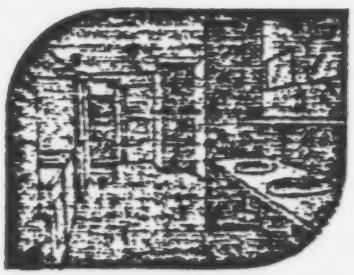
20 Man.
1 Nominal power requirement 15 Kw
2 Oil heat furnace
3 50 gal oil water heater
4 Complete washroom with 2 showers 2 toilets, 1 urinal 4 sinks and mirrors and 1 laundry tub
5 Steel toilet partitions
6 220 CFM ceiling mounted fan in washroom
7 Night tables and clothes closets
8 Wall mounted bunk lights
9 Complete fire alarm system
10 Coat hook boards
11 Continental beds c w mattresses
12 Curtains c w rod
13 Stacking chairs
14 Mirrors

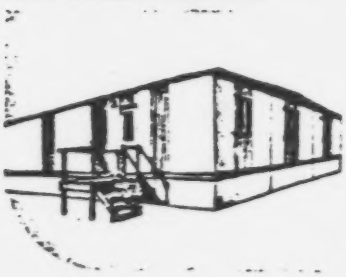


- Service entrance mast
- Main power panel
- Incandescent fixture
- Exterior light
- Bunk light
- Interior wall mounted fixture
- Single pole switch
- 3-way switch
- Fan switch
- Furnace switch
- Duplex receptacle
- Razor outlet
- Weatherproof receptacle
- 120 volts outlet
- Ceiling mounted fan
- Thermostat
- Fire detector
- Fire alarm bell
- Fire break glass station
- Fire alarm central station
- Exit light

standard features
Aluminum sliding windows. 2 Oil, forced air, gun burner type furnaces thermostatically controlled c/w in floor heat ducts. Incandescent lighting. Insulated walls, ceilings and floors. Light fixtures beside exterior doors. Heavy duty hitch and leveling stand. Electrically approved by CSA. One piece floor covering 0.080 gauge. Wall mounted bunk lights. Washroom c/w: 220 CFM ceiling mounted venting fan. One 50 gallon oil water heater. Two showers. Two water closets. Four sinks. One urinal. Four mirrors. One laundry tub. Ten night tables. Twenty clothes closets.

optional equipment & furnishings
Mirrors 14" x 16". Coat hook boards c/w 4 hooks each. 36" x 78" continental beds c/w mattresses. Curtains 42" x 48" c/w rod. Linen closets. Vestibule doors. Easy chairs. Stack chairs. Washer and dryer. Complete fire alarm system. Tridem axle running gear c/w electric brakes. Heavy duty, 8-14.5 12 PLY rated nylon tires, and wheels. Waste baskets.





standard technical specifications:

floor
¼" under sheathing. 2" x 6" joists at 16" o.c. 3" fiberglass insulation c/w vapour barrier. ⅜" plywood sub-floor. In-laid vinyl one piece floor covering. U-factor is 0.078.

walls
30 gauge prefinished metal siding beige with yellow feature panels. 5/16" plywood sheathing. 2½" fiberglass insulation friction fit. 2" x 3" studs at 16" o.c. 2 mil polyethylene vapour barrier. 4mm prefinished wall paneling colour coordinated in bedrooms and corridors. 4mm vinyl covered colour coordinated wall paneling for ease of maintenance in washroom. Black baseboard. U factor is 0.10. Partition framing is 2" x 2" at 16" o.c. Black gymp moulding.

roof
30 gauge galvanized steel one piece. 5/16" plywood sheathing. 2" x 6" rafters sloped to 2" x 4" at 16" o.c. 2" x 8" rafter crowned to 2" x 6" at 16" o.c. 4" fibreglass friction fit insulation. 2 mil polyethylene vapour barrier. ½" fibreboard with imprinted design. U-factor is 0.06.

doors
Exterior: thick metal construction c/w lock, colour coordinated with interior and exterior finish. Door size is 30" x 80".
Interior: thick hollow core wood construction 30" x 80" c/w lock. Colour coordinated with interior finish. Comes with master key set for maintenance force.

windows
30" W x 40" H aluminum horizontal sliding. Double glazed c/w vinyl thermo break and screen.

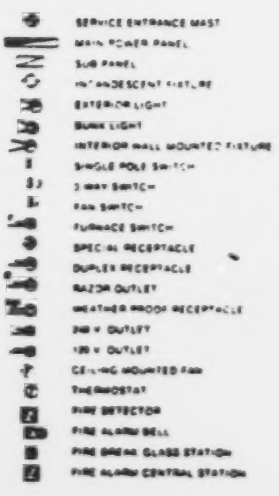
hitch
Welded on "A" frame c/w lunette eye and parking leg.

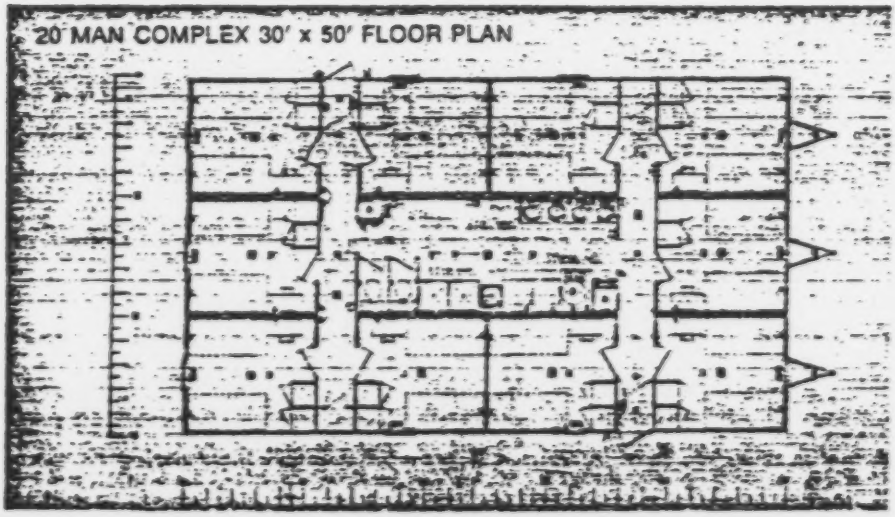
frame
Main members are 8" channel. Frame is coated with rubberized black paint.

electrical
115/230 volts, single phase, 3 wire, 60 cycle. Comes complete with mast, meter base and power panel. All wiring is concealed. Approved by CSA. Nominal power requirement is 15Kw.

plumbing
All fixtures, fittings and piping is CSA approved. The water supply system is designed for a maximum supply pressure of 80 P.S.I.
Oil line stub out is ½" ø black steel pipe. The water line is 1" ø copper pipe. Sewage discharges are 3" ø and 2" ø ABS.
The height of the outside units on running gear from ground level to roof level is approximately 10'8". The core unit is approximately 10'10".

The information contained herein was in effect at the time of printing this folder, however because of continuing product improvements and refinements, ATCO reserves the right to discontinue or change specifications, design and prices without notice and without incurring obligations.



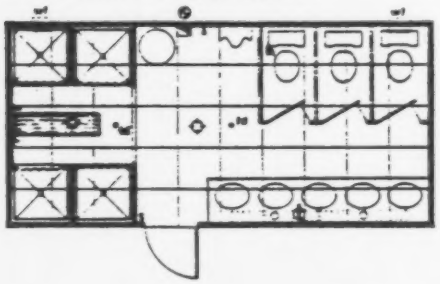


Washcar

Western

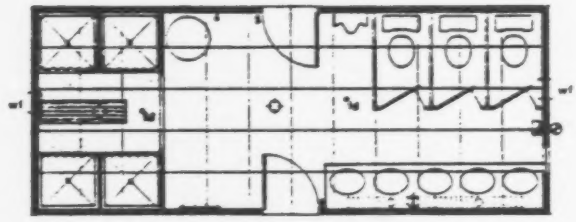
☐ WW-28-A Washcar

3.1m x 6.1m/10 x 20 ft.



☐ WW-33-W Washcar

3.1m x 7.3m/10 x 24 ft.



Legend:

- Electrical inlet
- Electrical panel
- Electrical outlet
- Light
- $ Wall switch
- Fluorescent Lighting

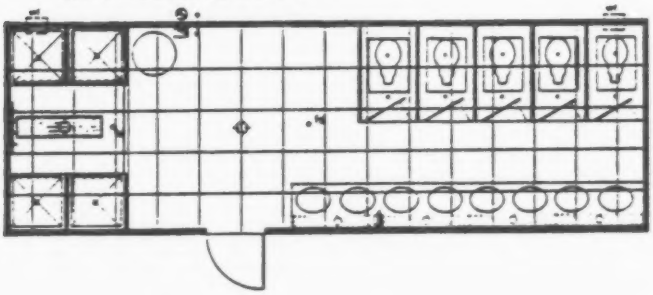
Scale ¼ in = 61m

2 ft

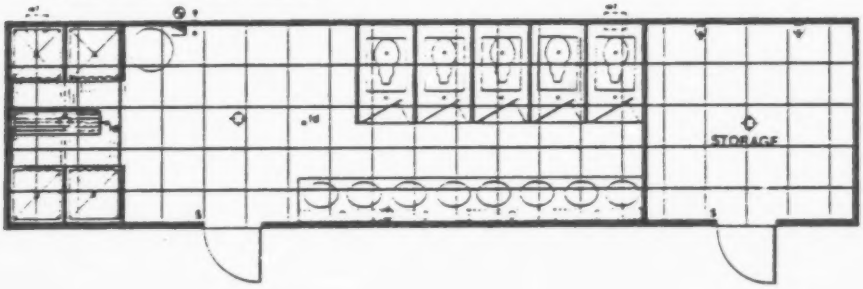
Washcar

Eastern

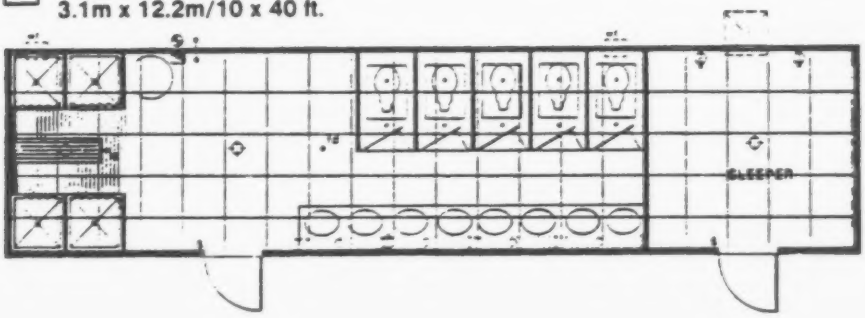
☐ WE-34-A Washcar
3.1m x 9.2m/10 x 30 ft.



☐ WE-35-H Washcar
3.1m x 12.2m/10 x 40 ft.



☐ WE-35-S Washcar
3.1m x 12.2m/10 x 40 ft.



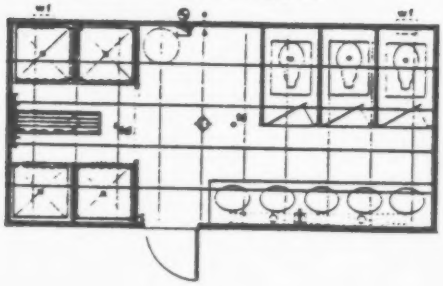
Legend:
- Electrical inlet
- Electrical panel
- Electrical outlet
- Light
- S Wall switch
- Fluorescent Lighting

Scale ¼ in = 61m

Washcar

Eastern

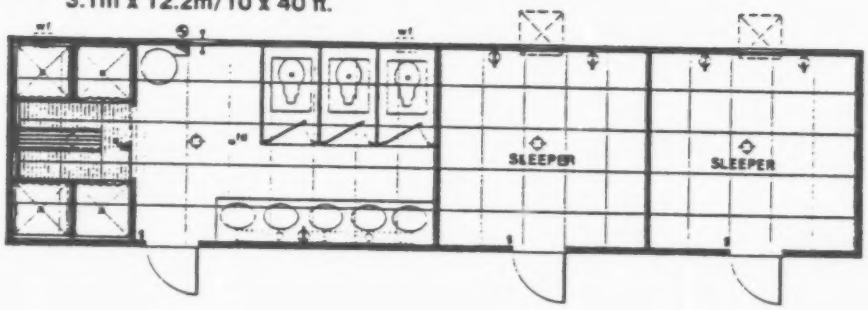
WE-28-A Washcar
3.1m x 6.1m/10 x 20 ft.



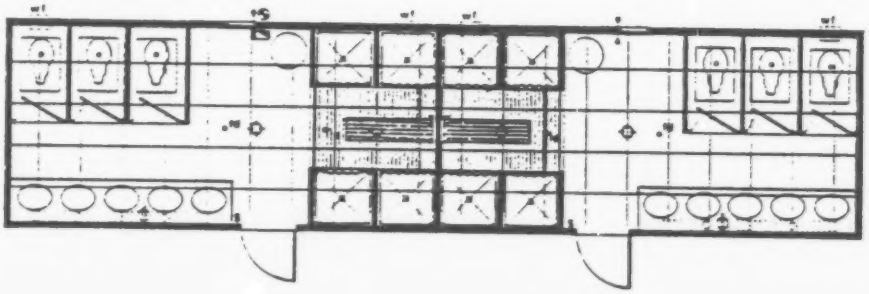
Legend:
- Electrical inlet
- Electrical panel
- Electrical outlet
- Light
- $ Wall switch
- Fluorescent Lighting

Scale ¼ in = 61m
2 ft

WE-32-S Washcar
3.1m x 12.2m/10 x 40 ft.



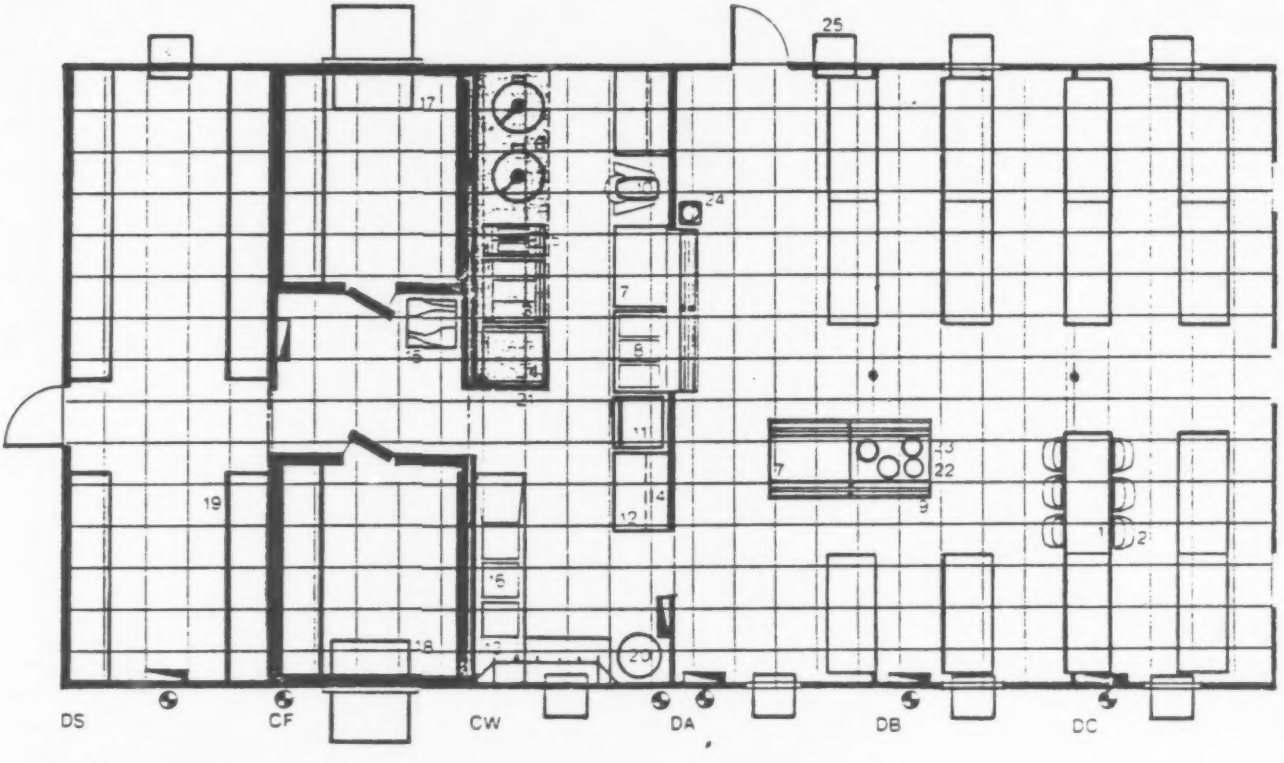
WE-37-A Washcar
3.1m x 12.2m/10 x 40 ft.



Kitchen Diner/Eastern Menu

167.2m²/1800ft²

☐ **KE-74-S**



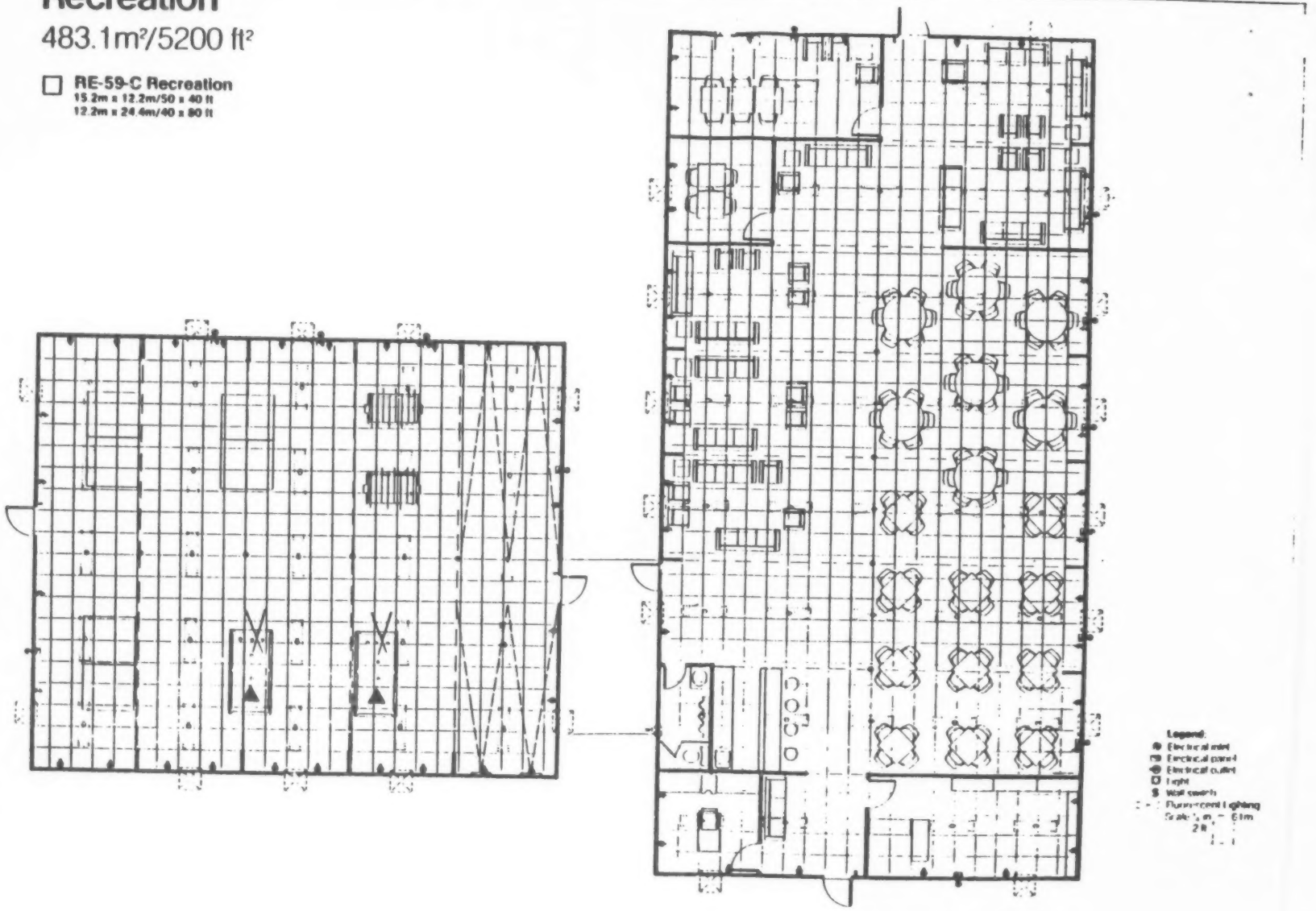
Features:

- Seating for 84 people
- Single main service line with two cold food and beverage lines
- ATCO engineered kitchens are caterer designed to provide maximum space utilization efficient and convenient operation
- All kitchens are supplied with industry proven equipment to give reliable performance
- Increased diner seating capacity is available by adding matching diner modules
- Additional dry and refrigerated food storage space needed for remote locations can be achieved by attaching standard cooler-freezer modules
- Kitchen construction materials are selected on the basis of their durability appearance and ease of cleaning
- Sanitary stainless steel work surfaces are featured
- Comfortable chairs are standard in all dining areas

Recreation

483.1m²/5200 ft²

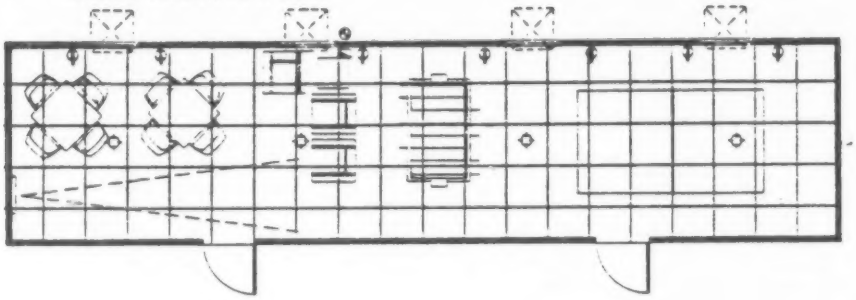
☐ **RE-59-C Recreation**
15.2m x 12.2m/50 x 40 ft
12.2m x 24.4m/40 x 80 ft



Recreation

37.2m²/400 ft²

RE-17-A Recreation
3.1m x 12.2m/10 x 40 ft



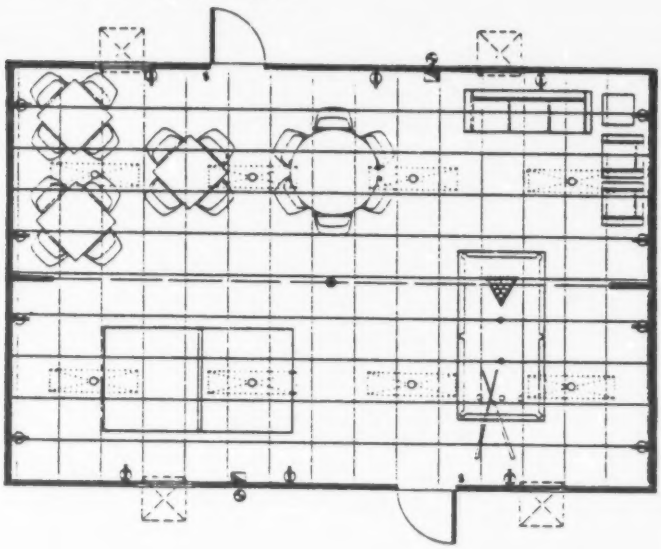
Legend:
- Electrical inlet
- Electrical panel
- Electrical outlet
- Light
- S Wall switch
- Fluorescent Lighting

Scale ¼ in = 61m
2 ft

Recreation

55.7m²/600 ft²

RE-51-A Recreation
6.1m x 9.2/20 x 30 ft



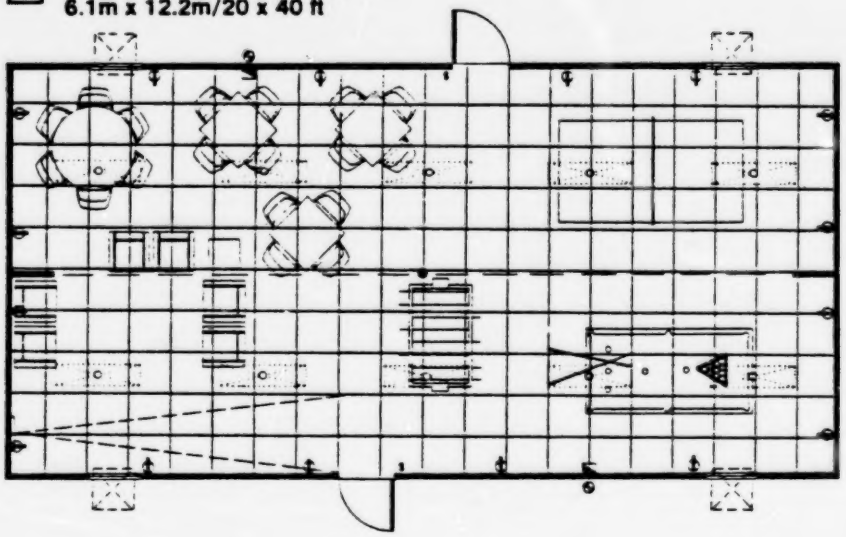
Legend:
- Electrical inlet
- Electrical panel
- Electrical outlet
- Light
- S Wall switch
- Wall Light
- Fluorescent Lighting

Scale ¼ in = 61m
2 ft

Recreation

74.3m²/800 ft²

RE-52-A Recreation
6.1m x 12.2m/20 x 40 ft



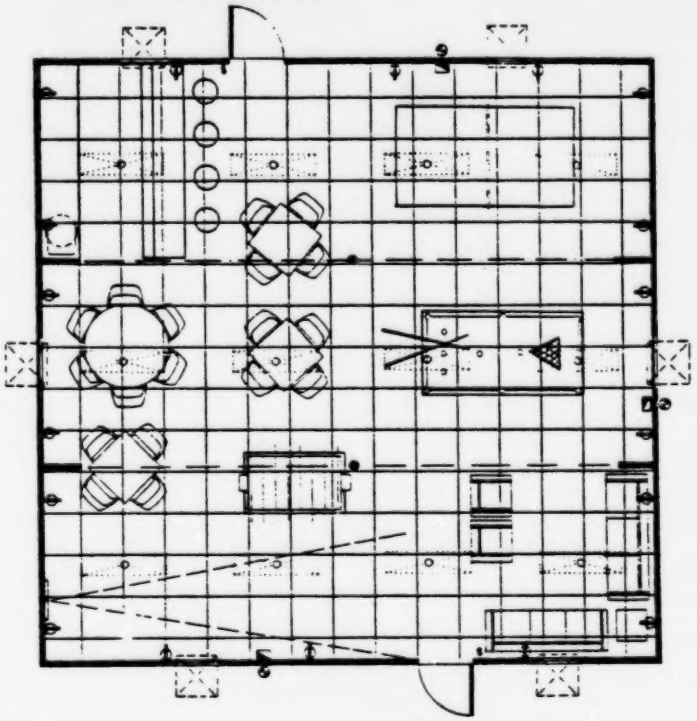
Legend:
- Electrical inlet
- Electrical panel
- Electrical outlet
- Light
- S Wall switch
- Fluorescent Lighting

Scale 1 in. = 61m
2 ft

Recreation

83.6m²/900 ft²

RE-53-A Recreation
9.2m x 9.2m/30 x 30 ft



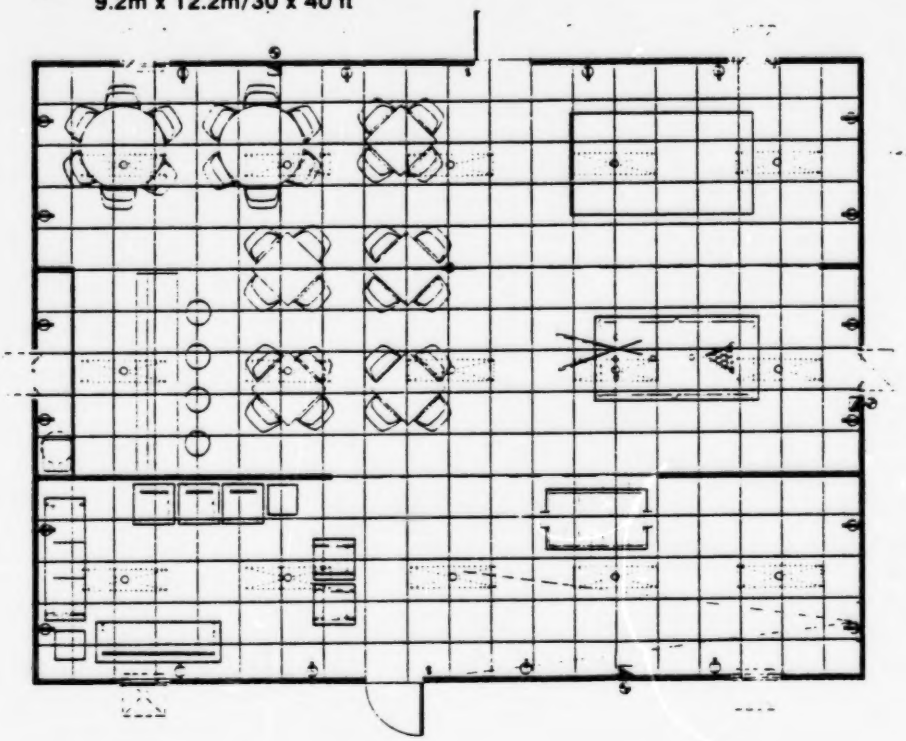
Legend:
- Electrical inlet
- Electrical panel
- Electrical outlet
- Light
- S Wall switch
- Fluorescent Lighting

Scale ¼ in = 61m
2 ft

Recreation

111.5m²/1200 ft²

RE-54-B Recreation
9.2m x 12.2m/30 x 40 ft



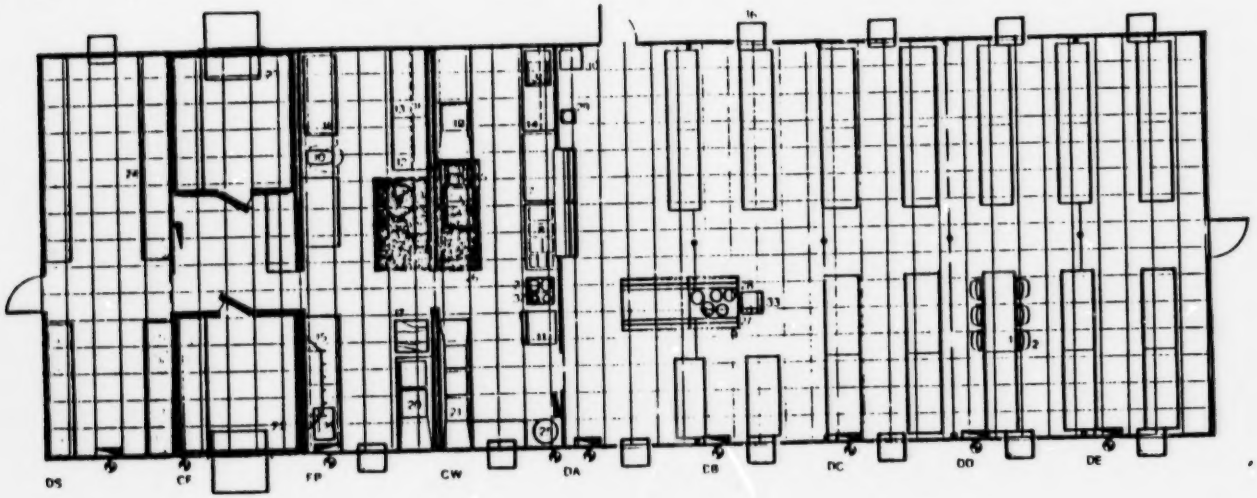
Legend:
- Electrical inlet
- Electrical panel
- Electrical outlet
- Light
- S Wall switch
- Wall Light
- Fluorescent Lighting

Scale 1 in = 61m
2 ft

Kitchen Diner/Eastern Menu

250.8m²/2700ft²

☐ **KE-75-S**



Features:

- Seating for 156 people
- Single main serving line with two cold food and beverage lines
- ATCO engineered kitchens are cateror designed to provide maximum space utilization, efficient and convenient operation
- All kitchens are supplied with industry proven equipment to give reliable performance
- Increased diner seating capacity is available by adding matching diner modules
- Additional dry and refrigerated food storage space needed for remote locations can be achieved by adding standard cooler/freezer modules
- Kitchen construction materials are selected on the basis of their durability, appearance and ease of cleaning
- Sanitary stainless steel work surfaces are featured
- Comfortable chairs are standard in all dining areas

Legend:

- Service entrance
- Electrical panel
- Canopy
- Optional equipment

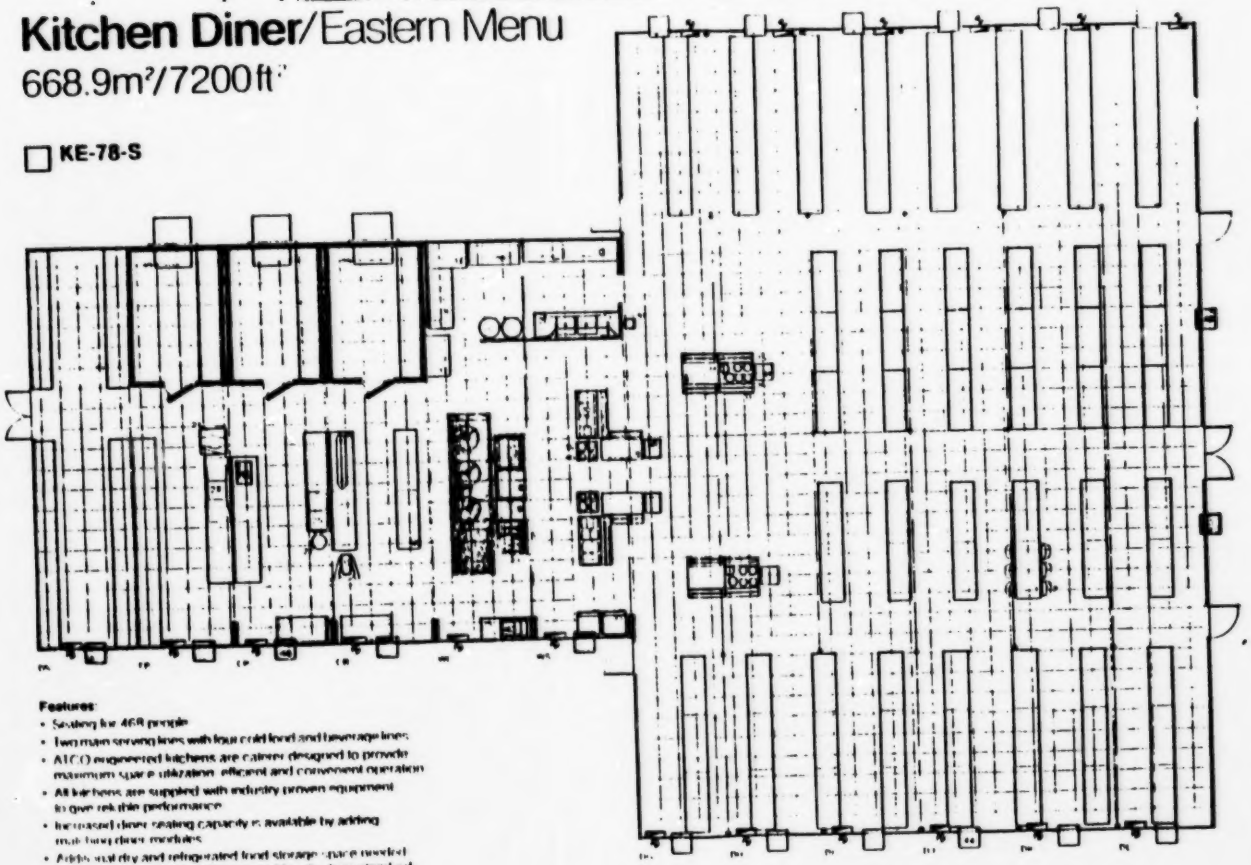
Scale: 1" = 6'-1"

2 ft

Kitchen Diner/Eastern Menu

668.9m²/7200ft²

☐ **KE-78-S**



Features:

- Seating for 468 people
- Two main serving lines with four cold food and beverage lines
- AICO engineered kitchens are cameo designed to provide maximum space utilization, efficient and convenient operation
- All kitchens are supplied with industry proven equipment to give reliable performance
- Increased diner seating capacity is available by adding mid-height diner modules
- Additional dry and refrigerated food storage space needed for remote locations can be achieved by attaching standard cooler/freezer modules
- The kitchen is designed with a large open food preparation area to facilitate supervision and layout variations
- Kitchen construction materials are selected on the basis of their durability, appearance and ease of cleaning
- Sanitary stainless steel work surfaces are featured
- Comfortable chairs are standard on all dining areas

Legend:

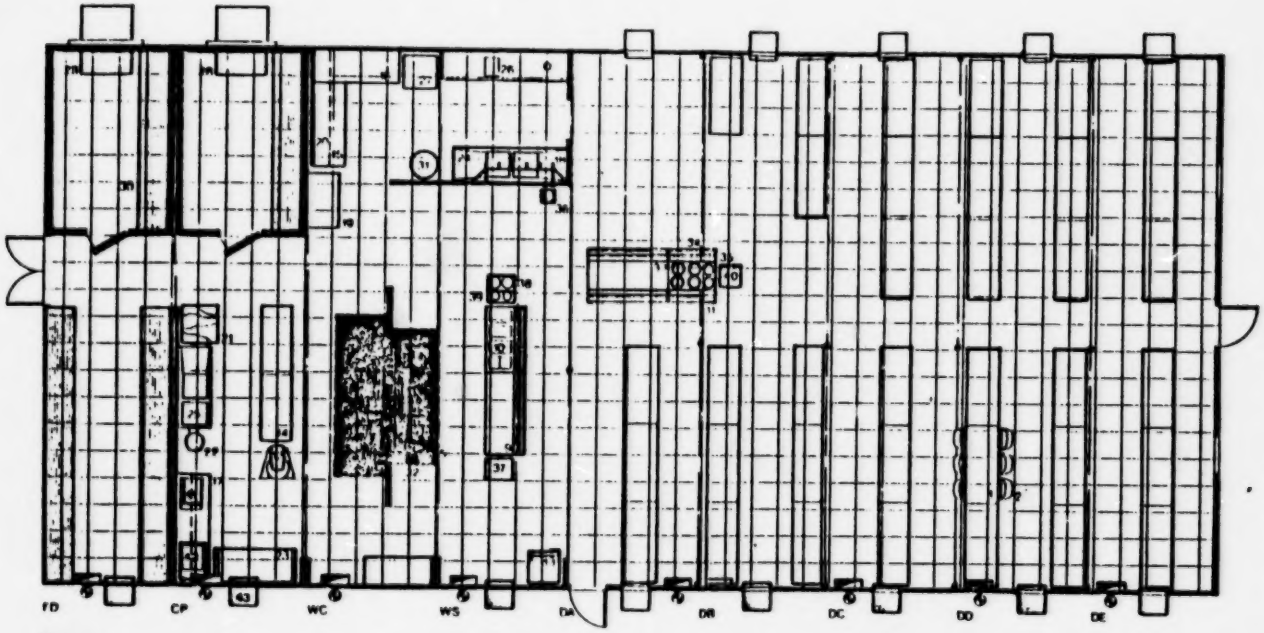
- Servers entrance
- Electrical panel
- Canopy
- Optional equipment

Scale 3/16 in = 61 m
2 ft

Kitchen Diner/Eastern Menu

334.5m²/3600ft²

☐ **KE-76-S**



Features:

- Seating for 216 people
- Single main serving line with two cold food and beverage lines
- ATCO engineered kitchens are cafeteria designed to provide maximum space utilization, efficient and convenient operation
- All kitchens are supplied with industry proven equipment to give reliable performance
- Increased diner seating capacity is available by adding matching diner modules
- Additional dry and refrigerated food storage space needed for remote kitchens can be achieved by attaching standard cooler/freezer modules
- This kitchen is designed with a large open food preparation area to facilitate supervision and layout variations
- Kitchen construction materials are selected on the basis of their durability, appearance and ease of cleaning
- Sanitary stainless steel work surfaces are featured
- Comfortable chairs are standard in all dining areas

Legend:

- Service entrance
- Electrical panel
- Canopy
- Optional equipment

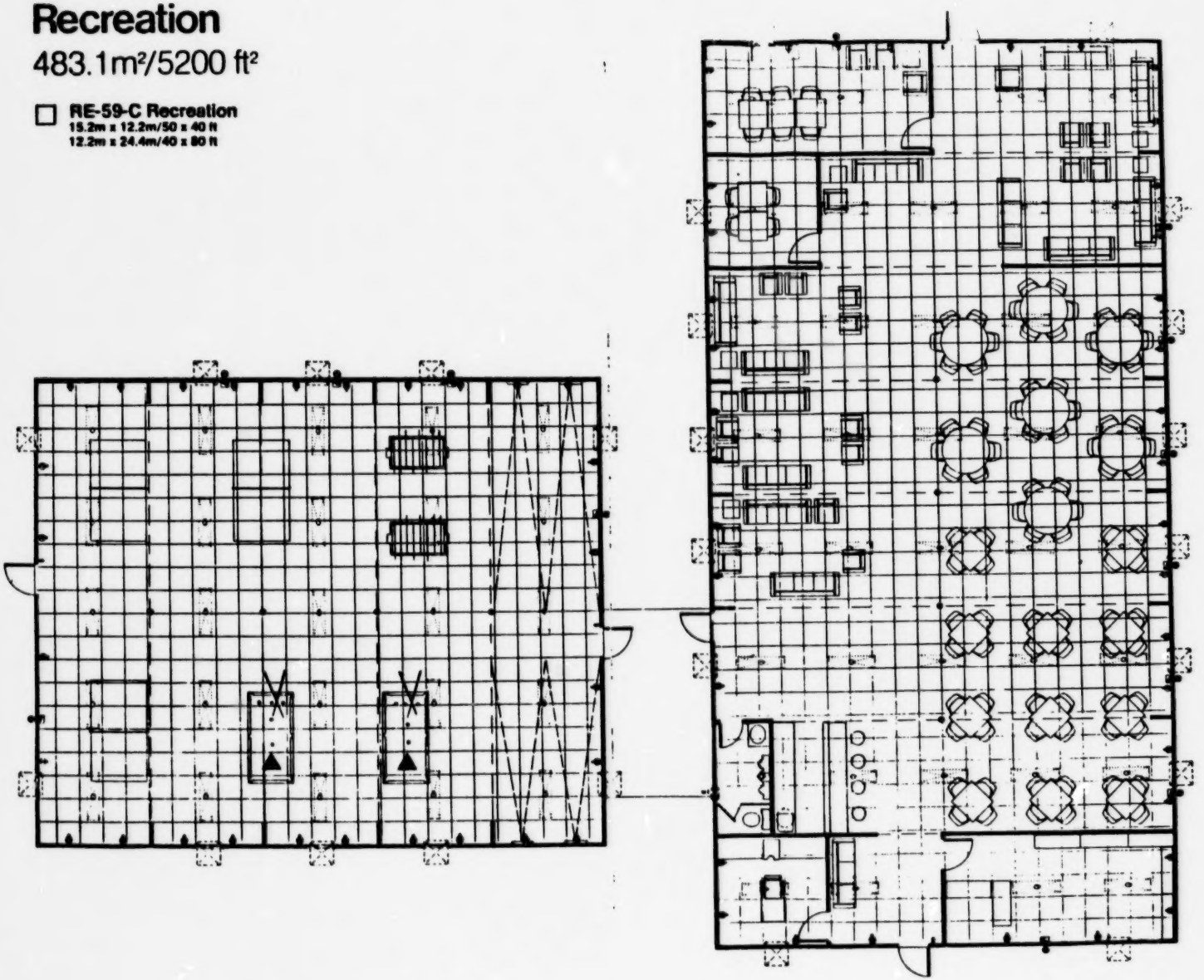
Scale: 1 in = 61 m

2 ft

Recreation

483.1m²/5200 ft²

☐ **RE-59-C Recreation**
15.2m x 12.2m/50 x 40 ft
12.2m x 24.4m/40 x 80 ft



Legend:
- Electrical inlet
- Electrical panel
- Electrical outlet
- Light
- $ Wall switch
- Fluorescent Lighting

Scale: 1 in. = 61m
2 ft

APPENDIX C. COMPARATIVE ANALYSIS EXISTING SITE AND UNIT DEVELOPMENT STANDARDS. TEMPORARY DISASTER HOUSING (DISCUSSED AT MEETING OF 5 MAY, 1982 AT NOSC, CMHC).

PLANNING FRAMEWORKS / SITE DEVELOPMENT STANDARDS

	H.U.D. Disaster Housing	C.M.H.C. Mobile Home	D.N.D. Base Layout	Summary Conclusions
Density	14.8-19.8 units	17 units/ha		
Units / Development	125 units max.	N/S	N/S	
Lot Size	12.8 m x 30.48 m (390 m^2)	12 m x 30.8 m (370 m^2)	N/S	
Setbacks				
Site-front yard	4.6m - 9.1 m	N/S	N/S	
side/rear yard	4.6m	N/S	N/S	
Lot - front yard	7.62 m 4.0 angled	Mun. Requir.	N/S	
side yard		1.2 m min.	N/S	
rear yard	6.1 m - 9.1 m	1.2 m min.	N/S	
Unit Separation	9.1 m	5.8 m	5 m Mobile Home 10 m Row Housing	
Amenity Area	8% of site (incl. 9.29 m^2 unit play)	45 m^2/unit OLA 45 m^2/unit other	N/S	
Vehicular				
Road Width	7.32 m		N/S	
Parking / Unit	1 / unit	1 / unit		
Visitor	1 / 4 units	1 / 6 units		
Other	N/S	1 / 6 units (R.U. storage)		

BUILDING FRAMEWORKS / UNIT DEVELOPMENT STANDARDS

	H.U.D. (Min. Livability)	Health & Welfare (Temporary Housing)	D.N.D.	U.S. Civil Defence	A.T.C.O. Mining Co's.	N.B.C. (Resid. Standards)
Unit Size	46.5 m^2 (2 bed.) 43.9 m^2 (3 bed.)					
Room Size						
Living	10.7 m^2	.7 m^2 / person				13.5 m^2
Dining	5.4 m^2				(1.4-2.0 m^2	3.25-7.0 m^2
Kitchen	5.3 m^2				(per person	4.2 m^2
Bathroom	3.0 m^2					
Bedroom	3.8 - 6.3 m^2	2.8 - 3.7 m^2/ person - dormitory)	7.4 m^2 / person (dormitory)	3.7 m^2/person	4.6-5.6 m^2/ person (shared)	7.0-8.8 m^2
Sanitation						
W.C.	1 / unit	5 / 100 people	10 / 100 W.C. 6 / 100 urinals			1/unit
Lav.	1 / unit	6 / 100 people	4 / 100 people			1/unit
Bath/Shower	1 / unit					
Water	473 - 530 L unit/day	45.6 L/person day				